A taphonomic investigation of the agency of microfaunal accumulation at Elands Bay Cave

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Contents

Abstract

Up until the present, analyses of micromammal assemblages in South Africa have been based upon the premise that the agent responsible for the accumulation of these assemblages was the Barn owl. These micromammal assemblages were used to make extrapolations of past changes in vegetation and climate. It was assumed that the agent of accumulation, the Barn owl, remained constant. This thesis used taphonomy to analyse the micromammal bones from Elands Bay Cave in order to question the traditional assumption of the Barn owl as predator and to ascertain which predator/s had been responsible for the accumulation of the microfaunal assemblages.

The methods used to identify the accumulator of the microfaunal assemblages from Elands Bay Cave were based on those used by Andrews (1990a) in his investigation of the bone contents of pellets and scats of several species of owl, diurnal birds of prey and small carnivores. The results from Andrew's (1990a) analyses provided comparative information on breakage patterns of the cranial and postcranial bones and on the acid etching (produced during digestion) on micromammal bones and teeth, caused by the various species of predator.

Information on the habits of various predators was collected. This information was used in combination with the results obtained from the analysis of the breakage patterns of the mandibles, maxillae and long bones, and from the acid etching on the incisors, in order to ascertain the agent of accumulation of the micromammal bones from Elands Bay Cave.

The breakage patterns of the long bones and the acid etching on the incisors of the micromammals indicated that a variety of predators had contributed to the micromammal assemblages in the Holocene packages of the site. The Terminal Pleistocene packages appeared to have been deposited by a Barn owl but there was some circumstantial evidence that people may have also been responsible for the accumulation of some of the micromammal remains in these packages. The results from this thesis indicate that taphonomy should be used to ascertain the predator of micromammal assemblages prior to using the assemblages to trace palaeoenvironmental change. The use of taphonomy at Elands Bay Cave highlighted some of the problems that may arise when dealing with small samples and also raised the issue of the affect that the period of deposition of an archaeological assemblage could have on the micromammal population represented. This thesis found evidence that contradicts the traditional assumption, usually made in the analysis of micromammal assemblages in South Africa, that short-term fluctuations in rodent communities may be safely ignored during analysis.

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Chapter One Introduction

1.1 Introduction

The site under investigation in this research project is Elands Bay Cave (EBC). This cave site is situated on the west coast (32°19' south and 18°19'east), approximately 180 km north-west of Cape Town, close to the small town of Elands Bay. The cave has been occupied or used by human inhabitants for varying intervals over a time period stretching from before 40 000 to 300 years ago. This thesis will use a taphonomic approach to investigate the agents responsible for the accumulation of the microfauna in the cave.

The taphonomic study of fossil microfauna is relatively new. This has been attributed partly to the lack of understanding of so many of the factors involved in fossilization and partly to the fact that microfaunal bones are so vulnerable to change and damage (Andrews 1990a). In South Africa and internationally, micromammals have, however, been used extensively in environmental and ecological research (Chaplin 1971; Redding 1978; Avery 1981, 1982, 1987, 1990, 1992; Andrews 1990a; Fernandez-Jalvo and Andrews 1992; Scott *et al.* 1996, Vigne 1996). Thus far the micromammal remains from archaeological sites in South Africa have chiefly been analysed because of their usefulness as palaeoenvironmental indicators. The Barn owl preys on a broad selection of the micromammal population available, hence, of all the predators, it is the most useful accumulator of micromammal remains for palaeoenvironmental research. Most palaeoenvironmental analyses done on archaeological micromammal assemblages in South Africa have been based on the premise that the agent responsible for the accumulation of these assemblages was the Barn owl (Avery 1981; 1982, 1987, 1990, 1992). Aspects such as the change in mean size of the individuals of a species or changes in species diversity of the fossil micromammal assemblages have been used in the extrapolation of past changes in vegetation and climate. These extrapolations assumed that the agent of accumulation, the Barn owl, remained constant.

No literature dealing with the taphonomic aspect of the microfaunal components of archaeological sites in South Africa was found. Taphonomic studies on the microfauna from European sites have, however, provided information which has enabled the predator of the microfauna to be identified (Andrews 1990a, Fernandez-Jalvo and Andrews 1992, Fernandez-Jalvo 1995). The possible predators of the microfauna found on archaeological sites are humans, small carnivores and diurnal or nocturnal birds of prey. Ascertaining the predator of microfaunal assemblages on a site may be essential when making palaeoenvironmental interpretations - it helps to avoid the erroneous attribution of changes in the rodent population to environmental change when changes in predator or predator behaviour may have been the actual cause. Predator identification prevents the mixing of

assemblages from different predators during analysis and enables the analyst to take the predator's habits and idiosyncrasies into account in the analysis. This thesis attempts to trace the taphonomic history of the microfauna from Elands Bay Cave and to investigate the possibility that predators other than the traditionally accepted Barn owl may have been responsible for the accumulation of microfauna.

Traditionally, for palaeoenvironmental research, the mandibles and maxillae of rodents have been studied as the animals can be identified to species by looking at the teeth or at the alveoli patterns (Redding 1978; Avery 1981; 1982; 1987, 1990). Postcranial bones were not included in the analysis. This thesis has attempted to complement these studies by including both the cranial and postcranial bones. The term 'microfauna' is rather a broad one. In terms of this thesis it encompasses the rodent, insectivore, frog and lizard bones from the site. The analysis of the small birds found in the cave, which is being done by G. Avery of the South African Museum, is as yet incomplete and these bones were therefore not included in this thesis. Rodents formed the main bulk of the microfauna found on the site with insectivores and, particularly, frogs and lizards appearing in very low frequencies. As a result of the low frequency of lizard and frog bones, this thesis deals mainly with the micromammals found in the site. When the term 'micromammals' is used in this thesis it refers to the Murid and insectivore species found on the site. This thesis also explored the possibility that the micromammals at Elands Bay Cave may have represented food debris from the human occupants of the site.

The behaviour of both predator and prey should be taken into account when interpreting microfaunal remains. The prey species chosen by the predator reflects predator choice, which in turn is influenced by what is available in terms of the local rodent population. The main factors influencing rodent community structure are dealt with in some detail in chapter two as the population growth, density and diversity of fossil micromammal communities directly influences what prey is available to the predator. These issues also affect what species may appear in archaeological assemblages, depending upon the time period over which the sample was deposited. In contemporary studies of rodent communities the factors influencing community structure, population density and breeding remain incompletely understood. These gaps in our understanding of modern day rodent communities should be remembered when using indices such as diversity and changes in mean size for extrapolations of fossil rodent communities.

The methods used to identify the accumulator of the microfaunal assemblages from Elands Bay Cave were based on those used by Andrews (1990a) in his investigation of the pellets and scats of several species of owl, diurnal birds of prey and small carnivores. The results from Andrew's (1990a) analyses proved that it is possible to distinguish between five different categories of predator (these categories are listed in chapter two, Table 2.2), including diurnal and nocturnal birds of prey and

small carnivores, by looking at the breakage patterns of the cranial and postcranial bones, body part representation, and the acid etching (caused during digestion) on the micromammal bones and teeth. This thesis used the above tools in the analysis of the micromammals from the site whenever possible, so that the results obtained were comparable to those obtained by Andrews (1990a). The methods used by Andrews were not always applicable to the Elands Bay Cave assemblages, however, as Andrew's (1990a) pellet and scat assemblages had not been affected by the factors that had affected the Elands Bay microfaunal assemblages since deposition and subsequent excavation from the site. It was expected, therefore, that the signature left on the bones by the predator or predators of the microfauna from Elands Bay Cave may have been obscured or even totally erased by events subsequent to deposition.

Ascertaining the origins of the microfaunal bones is divisible into two issues, namely, the nature of the sediments in which the animal is found, and the attributes of the fossil assemblage (Andrews 1990a). This information can be used to determine the origin of the assemblage and the processes which may have affected and changed it since formation. Any analysis or interpretation of the bones can then take these biasing and distorting factors into account. In order to unravel the taphonomic history of the microfauna, the affects of weathering, trampling, water-action, soil alkalinity or acidity, and predation on the bones should be understood. Mechanical or chemical factors may have erased or altered the original signature or patterning of acid etching or breakage left on the bone by the predator. These are, however, distinguishable from the damage and alterations inflicted on microfauna by predators. Etching or corrosion on the bones caused by the soil is readily distinguishable from the etching caused by a predator and as Andrews (1990a) has provided a comprehensive picture of the breakage caused by various predators, post-depositional breakage on the site should be easily recognizable.

1.2 The site:

1.2.1 Elands Bay Cave: Past and present

Elands Bay Cave is situated in the side of Baboon Point cliff facing north-west, approximately 40 m above sea-level (Cowling and Parkington 1997). In the earliest times, the cave floor area was much larger than the present day with a rear chamber. The cave was half-filled with deposit at the time that excavations began (Parkington in prep.). Large rocks across part of the entrance provided extra shelter from the outside (Parkington in prep.). By the end of the Pleistocene, however, the rear chamber was blocked with deposit and the rocks in the front buried (Parkington in prep). Trenches have been dug at the rear of the cave by people stationed at the World War 2 radar station, the ruins of which are situated slightly downhill from of the cave.

The cave faces the Atlantic ocean and the tidal zone lies some 150 m away (Parkington in press). Rock art appears on the walls of the cave. The distance from dripline to the rear of the wall is approximately 11 m while the height is about 8 m (Parkington in prep). An area of sand and scrub lies directly in front of Elands Bay Cave. Stick and leaf nests and pathways through the vegetation indicate that there is an active rodent population in the area. Below is the beach which extends onto a rocky plateau, which in turn stretches into the sea. The nutrient-rich Benguela current flows past Elands Bay and supports a wide range of marine life. The Cape fur seal was an important source of protein to the inhabitants of the cave, especially when, after weaning, the 9-11 month old animals were beached, presenting easy targets (Klein and Cruz-Uribe in prep). Numerous shell fish species live on the rocky, inter-tidal stretches in front of the Cave.

From 18 000 - 14 000 years ago the coastline, which was probably about 120 m lower than today at the Last Glacial Maximum, would have been slowly, but progressively, drowned (Parkington in press). At 13 000 years ago the rising sea level would have covered several kilometres of low coastal plain and the shoreline would have been 12 to 15 km to the west of EBC (Parkington in prep). At 11 000 years ago, the shoreline shifted to within 5 km or so of the cave and at this point, the rocky shores reached their greatest extent and there was marked near-shore island creation (Parkington in prep). Some 8000 years ago the sea level was at present levels, it then rose to +3 m at its Holocene maximum around 6000 years ago. The last 4000 years saw the sea-level falling to present day levels (Jerardino 1995).

Baboon Point cliff dominates the landscape around the cave and extends steeply above it, providing numerous ledges and perches for birds and also places of refuge for smaller mammals. Behind Baboon Point stretch the sandy, coastal plains (Parkington in prep). Along the southern bank of the Verlorenvlei shales, sandstones and thinly bedded siltstones are covered by the mature conglomeratic sandstones of the Cape Supergroup (Miller 1987). Many caves or shelters in the quartzite kopjies of the south bank of the Verlorenvlei show evidence of habitation by hunter-gatherer inhabitants (Parkington *et al.* 1988).

The Verlorenvlei area is a transitional area in that it lies between the Karroid and Fynbos vegetation types (Sinclair *et al.* 1986). There are two variations of strandveld found in the area; a dense, dwarf semi-succulent scrub and an open, semi-succulent, fynbos-type form of the Strandveld proper vegetation (Acocks 1975). Weather monitoring stations at Redelinghuys and Doring Baai indicate that the annual rainfall at Elands Bay Cave, a winter rainfall region, falls between 275 mm and 150 mm (Parkington in prep). Very little summer rain falls and the coastal fog is a valuable source of moisture for the plants in the area (Sinclair *et al.* 1986). Figure 1.1 shows the regional topography of the Elands Bay area.

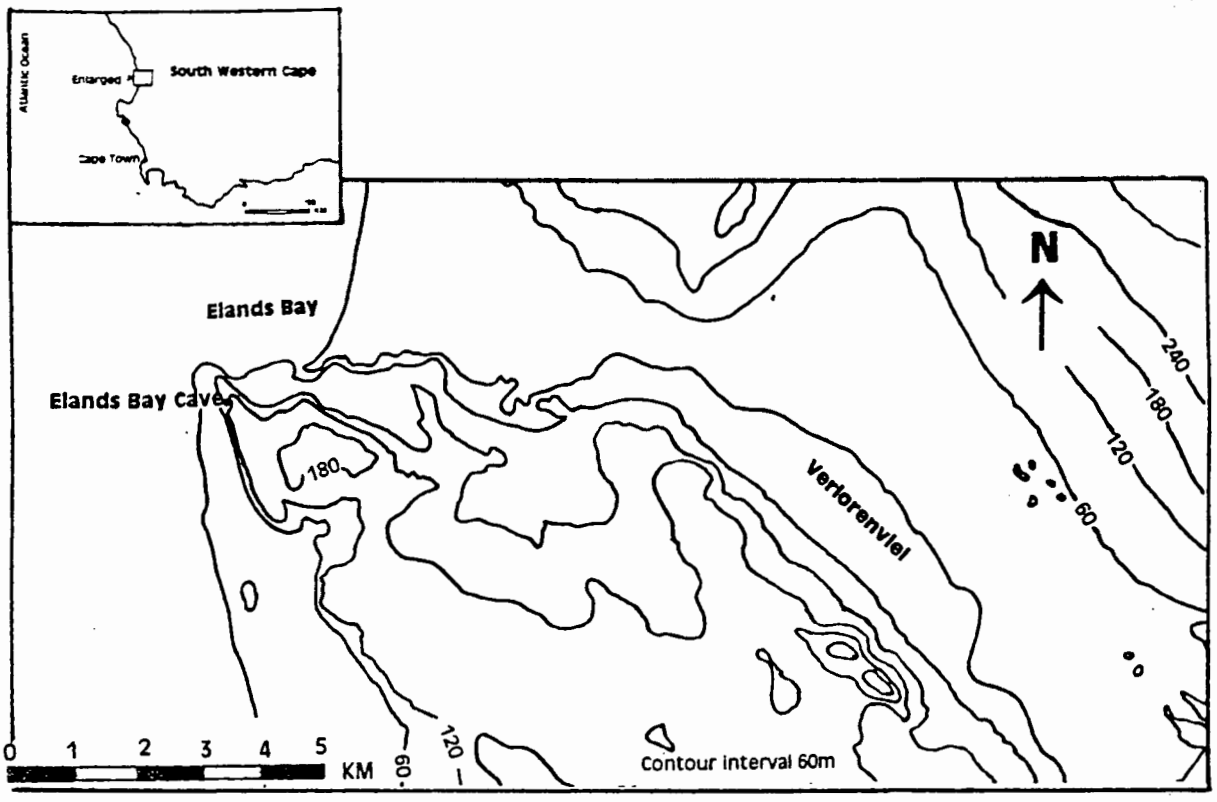

Figure 1.1: The location of Elands Bay Cave and the regional topography (After Parkington and Poggenpoel 1987: Fig. 1, page 270)

The 14.5 km long Verlorenvlei runs into the bay of Elands Bay itself and lies some 2 km from the cave (Miller 1987). The vlei provides another habitat close by to the cave and attracts a wide variety of animals. The vlei becomes saline from approximately 3-5 km from the mouth of the river, which may close as the water level in the vlei drops during summer (Parkington in press). In the past when the mouth of the vlei was open to the sea, estuarine and marine fish lived in the Verlorenvlei (Parkington and Poggenpoel in prep.) At the present day, however, the building of causeways and bridges has damaged the lower reaches. Reeds cover extensive areas of the vlei and provide shelter for the numerous species of water birds which live around the vlei. Avery (. in prep) notes that it is possible that, in times of lowered sea level, the vlei extended past and closer to the cave than it is today. An extension of the vlei or variations in the salinity of the water would have influenced the nature of the riparian vegetation, which would in turn have affected the micromammals living in the area (Avery draft paper). Figure 1.2 shows the present-day biomes around Elands Bay Cave.

Elephant, rhino, hippos, grysbok, rhebok, steenbok, klipspringer, springbok, red hartebeest, grey duiker, blue antelope, hares, dassies, molerats, porcupines, tortoises, snakes, a wide spectrum of carnivores and numerous micromammal species lived in the environs of Elands Bay Cave in the past (Klein and Cruz-Uribe in press). A species list of the micromammals found in the site appears in Appendix 1. A minimum of 25 insectivore and rodent species was found; four were shrews, two elephant shrews, three golden moles and 16 species of Muridae (rats and mice) (Avery in prep). All of the Muridae species excavated from Elands Bay Cave are found in the area today, the one exception being Saunder's vlei rat, which has a current distribution range which falls slightly south

of Elands Bay. All the shrew species found on the site, with the exception of two species, are found in the area today. The Red musk shrew is presently found further south than Elands Bay on the west coast and Smith's rock elephant shrew is presently found further to the north, near the Namibian border on the Namaqualand coast. The Cape molerat's distribution lies slightly to the south of Elands Bay today. Van Zyl's golden mole was also found in Elands Bay Cave. This is interesting as little is known of this species and only one specimen has been found at Lamberts Bay, the closest coastal town north of Elands Bay. Information on the current distribution patterns of the micromammals from the site was found in de Graaff (1981) and Skinner and Smithers (1990).

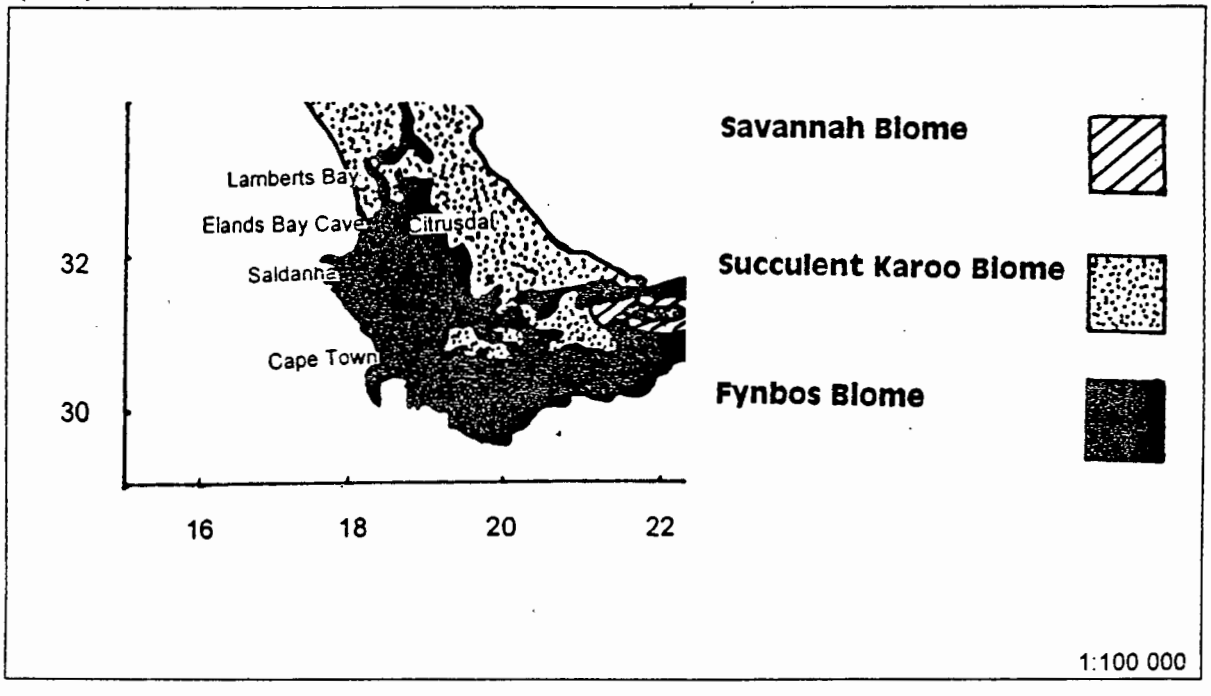

Figure 1.2: The biomes around Elands Bay Cave Today (After Rutherford and Westfall 1986: Fig.13, page 34)

1.2.2 The depositional units and excavation methods at Elands Bay Cave

J. E. Parkington, C. Poggenpoel and P. Robertshaw carried out excavations at Elands Bay Cave between November 1970 and December 1978 for a total fieldwork period of five months. The site was chosen because it promised to yield a rich and well preserved deposit and because, as a coastal site, it could provide information to test the seasonal movement hypothesis (Parkington 1987).

Excavations were done in metre squares and hearths, pits, post holes, disturbances, notable artefacts and the perceived edges of units were mapped but the vast majority of artefacts and remains were recovered after sieving (Parkington in prep.). Sieving is thus likely to have exacerbated breakage of the more fragile microfaunal bones and to have increased tooth loss from the jawbones. Sieving took place through 12 mm and 3 mm mesh sieves which were mounted together and almost all the primary sorting was done in the field. Fernandez-Jalvo (1995) notes that during the excavation of deposit at the site of La Trinchera de Atapuerca in Spain, the deposits went through three sieves, the

smallest being 0.5 mm. The 12 mm and 3 mm sieves used for Elands Bay Cave were, in hindsight, definitely not adequate for the retrieval of all microfaunal remains but at the time this problem was not apparent. Sandelowsky (1974) noted that a baker's meal sieve was needed to sieve microfaunal remains as some slipped through a 3 mm sieve. The 3 mm sieve used at Elands Bay Cave would, therefore, have let through the smaller bones, teeth or fragments of microfauna. Single teeth may also have been overlooked by the people sorting the material. Andrews (1990a) reported that there was incomplete retrieval by sorters of the single molars from some of the pellet assemblages and it appears that molars, even more than incisors, could be easily overlooked during sorting.

During the first season of excavation, no bucket count was kept. The bucket counts for the various units were later estimated from field notes and section drawings. Thereafter, however, 65 buckets were taken to represent a cubic metre of fill (Parkington in prep). By using the bucket count from the different units it was possible to calculate the density of artefacts or faunal remains and this was done for the microfaunal remains. The talus slope in front of the cave revealed a thin spread of shell and artefacts but it is not believed that any substantial fill from the cave has been lost here (Parkington in prep).

The stratigraphy in the cave showed extreme spatial variability (Parkington in prep). Cartwright and Parkington (1997) note that short, pulsed periods of occupation appear to be represented in the site and the nature of both occupation and deposition appears extremely episodic. There are, interestingly, no sterile horizons between these pulsed deposits, though dating of deposits indicates that there were several hiatuses in occupation of the cave (Parkington in prep). The cave deposit was excavated in depositional 'units'. Units were distinguished on the basis of relative amounts of shell, the fragmentation and composition of shellfish and their orientation, grasses, ash, twigs, spall or differences in the matrix (Parkington in prep). During excavation the principle of splitting rather than lumping together deposits was used in defining units. Deep but uniform layers were divided into spits of approximately 50 mm. These 'units' are thus the smallest measurements of different areas in the site. Each unit was given a name, and a letter and number which corresponded to the metre square within which the unit was found. Figure 1.3 shows the horizontal division of the cave into metre squares. Vertical control was established by using a level to survey heights against a permanent datum mark made in the bedrock of the cave.

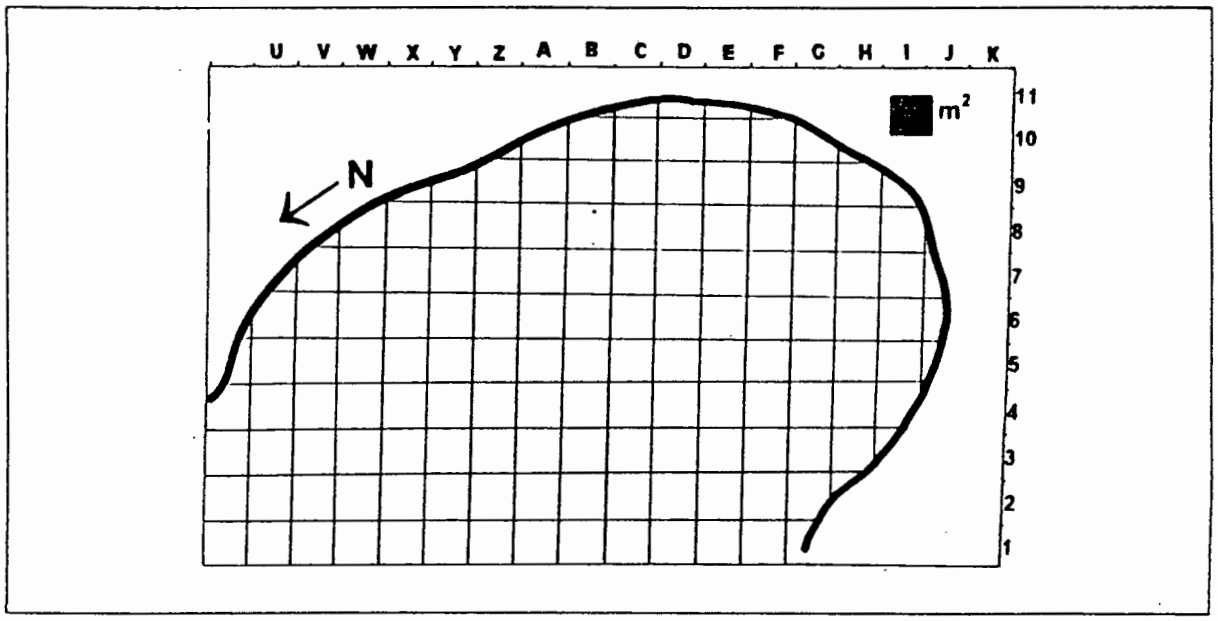

Figure 1.3: The metre squares at Elands Bay Cave

For the purposes of analysis, the units were then aggregated into packages and in some cases, sub-packages, based upon the ^{14}C dates obtained (see Appendix 2). The formation of packages provided another tool with which to analyse the data as the units were often rather arbitrarily allocated and the aggregating of units into packages allowed for the investigation of trends between packages. Parkington (in prep) notes that many of the depositional units were made up of permeable, shelly middens where vertical transport of material was possible, especially the transport of small items. This may be especially true in pulse C where there were loose and homogeneous shelly middens. The exact borders of the different units in the areas of the site where these shelly middens exist may, therefore, be taken to be rather indeterminate and there is a possibility that material may have become associated through movement or through the digging of burials or pits by inhabitants of the cave. The aggregation of units into packages thus helped in the analysis of areas of the site where deposits may have overlapped or become somewhat mixed. The formation of packages was also useful in that some of the units were very small and contained too small a number of artefacts for analysis. The formation of packages and sub-packages thus gave the analyst more flexibility and allowed small units to be included in analysis. Packages and sub-packages were then, in turn, added together to form pulses (these were numbered alphabetically beginning with pulse A at the top) which were the largest units of measurement of the deposits at Elands Bay Cave and allowed for the analysis of trends over thousands of years. A list of the unit names, the acronyms used for these names, and the packages and pulses into which the units are grouped may be seen in Appendix 2.

Pulse H, the pulse at the base of the cave deposits, lies directly over bedrock and has been sampled only in an area of approximately 1.5 m^2. This pulse contains many stone artefacts but no plant or faunal remains and Parkington (in prep) suggests that it may represent a quarrying scree. The three pulses above Pulse H, pulses E, F and G, are composed of approximately 1.3 m of sandy loams rich in charcoal and ash with some spall. Pulse E corresponds to the Last Glacial Maximum with

radiocarbon dates ranging between 17 000 and 22 000 years ago and appears to be separated from Pulse F by an unknown time period. Pulse F and G are separated by a layer of *in situ*, weathered quartzite blocks. Very few microfaunal remains were recovered from all of these pulses.

Pulse D, which is transitional in the sense that it spans the Pleistocene to Holocene boundary, is defined by two hiatuses, that between 17 800 (SPIN) and 13 600 years ago (MOS1), at the base, and (MARO) 8 100 to and (SHAK) 4 350 years ago at the top. The transitional packages, packages 10 to 19, contain a series of 'brown soils' and it has been suggested that these soils represent living floors, while the more shelly middens represent refuse heaps (Parkington in prep). The series of brown soils contained in this pulse are very similar to those observed at Nelson Bay Cave and other cave sites in Southern Africa (Klein 1972). Parkington (in prep) suggests that these brown soils could represent a unique period of occupation during the Pleistocene-Holocene boundary where people were reacting to changes in the sea level and climate. At 11 000 years ago, corresponding to the increase in sea-level to some 5 km away from EBC, shells begin appearing in the cave sediments (Cartwright and Parkington 1997). Parkington notes that in Pulse D, loams are replaced by shell and loam sediments, then by shell middens with a large loam content and, finally, by shell middens 'proper'. The deposits at Elands Bay Cave show a remarkable density of large faunal remains in the units dated to the Terminal Pleistocene, with over 45% of the deposit removed from the cave falling into this pulse, pulse D. The sudden increase in the density of artefacts and the bovid, seal, fish and shore bird bones in this pulse indicates that Elands Bay Cave was used intensively by people between 11 000 and 9000 years ago. At the top of pulse D (package 10), however, the sediments become more like the Holocene shell middens which lie above it, implying that this phase had passed by 8000 years ago (Parkington in prep). The marked peak in the density of artefacts and bones in the Terminal Pleistocene levels contrasts to the patterning observed in the Holocene units where the considerably lower level of density of artefacts and bone indicates that visits were far more brief. The surface of pulse D shows evidence of considerable trampling and there is extensive evidence of burrowing throughout this pulse. The density of microfaunal remains in this pulse varies, but some relatively substantial accumulations are found.

It appears that the cave was rarely visited by people about 7900 and 4300 years ago. Occupation at other sites in the Lamberts Bay and Elands Bay areas also experienced a period of non-occupation at this time (Jerardino and Yates 1996; Klein 1991). After 4300 years ago, however, regular but intermittent use was documented in pulse C. Pulse C, in contrast to the Terminal Pleistocene levels, contained the lowest densities of marine and terrestrial large mammal bone found in the site, though some of the packages in this pulse contained relatively large samples of microfauna. Most of this pulse consisted of deep, loose and homogeneous shelly middens which appeared to have a substantial windblown component and were very fragmented.

Little evidence of use of the cave is seen between about 3200 and 1700 years ago. Once again, the next period of non-occupation for the cave is repeated in other sites, such as Tortoise cave, in the area (Jerardino and Yates 1996). This is the time period in which the large, open "megamiddens" have been dated to and it has been suggested that these middens may represent a component of a shift in settlement patterns (Parkington 1991). At EBC the deposits which date to between 2000 and 3000 years, comprise no more than two cubic metres of deposit.

Parkington (in prep) notes that there appears to have been three breaks in the occupation of EBC during the last 3000 years, one short, the other two longer. No radiocarbon dates have been obtained for the period from 500 - 1000 years ago. Open sites around the Verlorenvlei date to this period, but the explanation for this is not yet clear. The period between 1800 and 2100 years ago and that between 1550 and 1450 years ago also appear to have been times at which the cave was not used. Pulse B dates from 1550 to 2200 years ago Pulse B shows shellfish characteristics which are more similar to Pulse C than Pulse A.

Pulse A dates from 1400 - 300 years ago. The density of marine material in pulse A approaches, and at times exceeds, that of the Terminal Pleistocene in some units. Sub-package 3b contained a number of wide-spread dates and does therefore, appear problematic. Fieldnotes suggest that the unit BUTH was also dubiously identified in some squares. The units containing ceramics, belonging to Pulse A, contained a large amount of twiggy material and also other plant remains such as terrestrial grasses, corms and seeds.

1.2.3 Elands Bay Cave: The palaeoenvironment

Dune molerat size and rainfall have been meaningfully correlated both in modern and fossil samples (Klein 1991). Klein (1991) studied molerat size on several sites (including Elands Bay Cave) on, or close to, the west and south coast. He calculated the mean historic rainfall of the area and then from this calculated a regression line, predicting the mean size of the molerats, given the historic rainfall (Klein 1991). The mean size of the molerat humeri from Elands Bay Cave was significantly greater than the samples from sites for which no deviation from historic climate is suggested. This, together with the fact that mean humerus breadth fell consistently above the regression line from which mean size would be predicted from historic rainfall, indicated that the climate was more moist from approximately 14 000 until about 8000 years ago (Klein 1991). Mean humeri size also indicated that there was a relatively dry period between 8000 and 4000 years ago, the period at which Elands Bay Cave appears to have been very rarely visited. The relatively large size of the distal humerus of the dassie bones from Elands Bay Cave in the levels dated to between 13 600 and 7900 years ago likewise suggests that the Elands Bay Cave region was moister during this period (Klein and Cruz-Uribe 1996).

The presence of the bushpig (found in package 15) and southern reedbuck (in packages 11 and 19) suggest more mesic conditions with greater precipitation between 13 600 and 7900 years ago (Klein and Cruz-Uribe in press). The presence of reedbuck may indicate grassier vegetation, a suggestion which is further validated by the marked abundance of zebra in packages 15 to 19. Large ungulates are more common in The Terminal Pleistocene packages (packages 19 to 10). Klein and Cruz-Uribe (in press) note that the diversity and number of grazers declined sharply in the early Holocene, suggesting that grassland was replaced by fynbos-bush-forest mosaic.

The micromammal remains from Elands Bay Cave were studied by D.M. Avery of the South African Museum in order to ascertain changes in climate and vegetation over the time period the micromammals were deposited (Avery in prep). This draft paper is currently under revision. The two best represented species in the site were the Bush karoo rat and the Namaqua rock rat. The Bush karoo rat strongly dominated the Terminal Pleistocene and early Holocene (before the mid-Holocene hiatus) deposits and this species presence was interpreted as representing closed, dry vegetation. The Namaqua rock rat dominated the Holocene deposits from package one to package nine. An analysis of the Terminal Pleistocene packages, packages 15 to 19, led Avery to conclude that these packages represented conditions different to those occurring at any other time. Avery concluded that the vegetation remained dry throughout the period covered by the micromammalian evidence, with a peak at about 10 000 years ago. Scrub and bush predominated throughout but there was an increase in grass around 13 600, 4000 and 500 years ago, with mild conditions existing around 13 600 and 4000 B.P. A reduction in species diversity was correlated with the neoglacial conditions brought about by the Younger Dryas and Avery suggests that the early Holocene climate around Elands Bay Cave was more extreme and more unpredictable than at any other time in the period under analysis.

The charcoal and pollen sequences from Elands Bay Cave fitted in with the macrofaunal and palynological evidence, all of which suggested wetter Terminal Pleistocene conditions (Klein 1991; Klein and Cruz-Uribe 1996; Cowling, Cartwright and Parkington in prep). The presence of proteoid fynbos from levels dated to between 12 450 and 13 600 years ago is good evidence for improved soil moisture status, relative to today (Klein and Cruz-Uribe 1996). The charcoal and pollen evidence from Elands Bay Cave suggests that during the Last Glacial Maximum a relatively diverse, mixed subtropical/Afromontane forest existed and there appears to have been greater fuelwood species diversity (Cowling, Cartwright and Parkington in prep). This was replaced, for most of the Holocene, by a xeric thicket and asteraceous shrubland (Cowling, Cartwright and Parkington in prep).

2.1 The accumulation of microfauna in archaeological sites

Microfaunal bones may become associated with an archaeological deposit in varying ways. The animals could have died naturally in the site or they may have been brought there through predator action. They could have become trapped, for example, in a pit, or by a rock or landfall or they may have experienced hibernation or aestivation deaths. In such a case the skeletons of these animals should be more or less complete and should not be damaged (unless the animal has been crushed) and the number of species preserved should be limited (Andrews 1990a). Microfaunal bones may accumulate in shafts or fissures, or by water movement (Chaplin 1971). The caching of food by small carnivores or the collecting of bones by harvester ants may also result in the accumulation of microfaunal bones (Andrews and Evans 1983). At most sites, however, rodents are introduced by roosting birds of prey or by mammals (Redding 1978). It is interesting to note that bones do not survive the digestive process of snakes and they could not, therefore, be responsible for accumulations of microfauna (Andrews 1990a).

Bones may become deposited on a site in a predator's scats or pellets which, over time, become disaggregated, forming a pocket of bone in the site. Another option, which has been relatively unexplored on archaeological sites in South Africa, is the possibility that humans may have been responsible for the accumulation of microfauna such as rats and mice. This chapter gives some background on the formation and expulsion of pellets and scats, and also on the effect of the human digestive system on micromammal bones. This information provides some background as to the processes which affect the bones during pellet and scat formation and the variables which may be introduced by different species of (or even different aged) predators. It also deals with some of the issues relating to sample accumulation and the interpretation of micromammal archaeological assemblages. The results from Andrews' (1990a) analyses of the scats and pellets of various predators are then dealt with in some detail as his results, and to a large extent, his methods, were used to interpret the bone breakage and incisor etching patterns of the micromammals from Elands Bay Cave. This section is followed by another which deals with some of the factors affecting the relationship between predator and prey, especially as regards choice of prey by the predator.

A list of predators and their diet and habits may be found in Appendix 3. Information relating mainly to the diet of the various predators' and the accumulation of microfauna has been recorded. Table 2.1 below summarises the diet, habits and likely areas of accumulation of scats or pellets for the owls, viverrids and canids listed in Appendix 3. Mustelids and felids are not likely accumulators

of microfaunal remains due to the destruction they cause to the bones they consume. The diurnal birds of prey (these are dealt with briefly in Appendix 3) are also unlikely accumulators of prey at Elands Bay Cave as they do not roost in caves. It is not impossible, however, that bones from diurnal birds roosting on the cliffs may have fallen into the cave. A more detailed discussion dealing with which predators are most likely to have been responsible for the accumulations of microfauna at Elands Bay Cave may be found in chapter six.

Table 2.1: Predators: Habits and the accumulation of pellets and scats*

	Diet	Habits	Living/nesting area (area where pellets and scats are likely to accumulate)
Owls			
Barn owl	Rodents, shrews, amphibians, birds, reptiles	Nocturnal	Roosts on ground, rocky ledges, buildings or trees
Cape Eagle Owl	Rodents, shrews, golden moles, hares, dassies, hedgehogs, small carnivores eg. genet, civet, squirrels,	Nocturnal (but has also been reported as partly diurnal)	Roosts on the ground or on ledges in shady, protected places, the nest consists of a few pellets scraped together
Spotted Eagle Owl	Insects, small birds and mammals, amphibians, reptiles, birds, fish and possibly carrion.	Nocturnal (but has been seen hunting in the day)	Roosts in a tree or on the ground, on rocky ledges, occasionally on buildings
Giant Eagle Owl	Large range of prey sizes taken; monkeys, other owls, birds, hares, small carnivores, rodents, shrews, moths and insects	Nocturnal, but has been recorded hunting during the day	Often roosts in the nests of other birds
Marsh Owl	This species eats aquatic insects, frogs, lizards and, very rarely, small birds	Starts hunting a couple of hours before sunset	This gregarious owl is often found in groups and lives in grassy, marshy areas
Wood Owl	Mice, frogs, insects, crickets, caterpillars and small birds	Nocturnal	Nests in trees or hollow logs
Grass Owl	Eats mainly rodents, diet similar to that of the Barn owl but not so catholic	Nocturnal	Roosts in nests in the grass, usually near streams and vleis, but also in lightly wooded country
Viverrids			
Small Grey Mongoose	Insects form substantial part of diet, rats, mice, ground birds, nestlings and eggs, reptiles, Arachnida and wild fruit	Diurnal, most active in the morning and from late afternoon to dusk.	Shelters in burrows, rock piles or holes in rock outcrops
Large Grey Mongoose	Murids, snakes, fish, frogs, crabs, Arachnids, millipedes, reptiles and insects	Nocturnal but also active during the day (may vary from area to area)	Animal is usually associated with riparian vegetation, found along dams, rivers, lakes and swamps
Yellow Mongoose	Mainly invertebrates, locusts, termites, small mammals, birds, amphibians, plants and carrion	Mainly diurnal though has been reported as being active at night	Latrines accumulate near the entrance of communal burrows
Water Mongoose	Mainly crabs and amphibians but also small rodents, birds, fish, reptiles and wild fruit	Mainly nocturnal, but also crepuscular	Latrines accumulate near water such as rivers, dams, estuaries, lakes and swamps.
Suricate	Predominantly insectivorous, but also invertebrates, birds and reptiles	Completely diurnal	Live in communal burrows
Small Spotted Genet	Selects smaller prey species (usually Muridae), small lizards, birds, fish and amphibians	Strictly nocturnal.	Droppings accumulate at latrine sites, usually in the open. Rests in holes in ground, hollow trees or piles of boulders during the day
Canids			
Bat Eared Fox	This species is very adaptable and eats what is available; termites, rodents, wild fruit, invertebrates, insects, reptiles and grasses	Diurnal & nocturnal	Scats and latrines are often used to mark areas around the communal den. Latrines may also be formed in other areas e.g. around a bush
Black-Backed Jackal	Opportunistic; insects, carrion, rodents, birds, arachnids, wild fruits, reptiles, tortoises, and crabs	Diurnal & nocturnal	Scats usually deposited within a small area.
Cape Fox	Insects, invertebrates, rodents, reptiles, birds, carrion and wild fruit	Mainly nocturnal, but also crepuscular	

* This table was compiled from the data on some of the predators listed in Appendix 3

Not all the predators listed in Appendix 3 show a current distribution in the Elands Bay area, although this does not necessarily mean that past distribution patterns did not extend into the area.

Some of the predators listed in the Appendix 3 are not potential accumulators of the microfauna at Elands Bay Cave for a variety of reasons. Likewise, much of Andrews' results deal with European species of predators which are obviously not potential predators of the microfauna from Elands Bay Cave. These predators have been included in this thesis, though they are not candidates for accumulation, in order to build up a comprehensive framework within which the assemblages from Elands Bay Cave may be placed.

Potential predators of the micromammals at Elands Bay Cave are also potential agents of accumulation of the hyrax, dune molerat, hare and hedgehog bones found on the site. The distribution of these bones throughout the site is compared to that of the micromammals in order to ascertain if they appear to be related in any way. The Spotted eagle owl, Giant eagle owl (the Giant eagle owl is referred to as the Verreaux eagle owl by Andrews (1990a)) and Cape eagle owl preys on the above species, though the Cape eagle owl is the most likely candidate as it tends to concentrate on one of the larger species of rodent as its main prey item. The molerats at Elands Bay Cave were analysed separately from the micromammals and Klein and Cruz-Uribe (in prep) suggest that the Cape eagle owl may have been responsible for their accumulation. The hyrax bones from the site show a breakage pattern which rules out the Black eagle as the predator (Klein and Cruz-Uribe in prep).

2.1.1 Pellets: Formation and contents

Owls are not the only birds that regurgitate pellets; robins, starlings and rooks, magpies, skuas, vultures, condors and herons (Glue 1973) as well as the kingfishers and curlews all expel pellets (Lloyd and Lloyd 1969). All four of the raptor families, the Tytonidae and Strigidae (owls), the Falconidae (falcons) and the Acciptridae (hawks, harriers, eagles and kites) regurgitate pellets regularly (Lloyd and Lloyd 1969). Birds may occupy a roost for months or years and a pair may nest at the same roost site for several years where extensive collections of pellets may build up (Steyn 1982). Pellets may be found at day-time roosts or night-time feeding stations, this varies from species to species (Glue 1973).

The pellet is formed in the gizzard and passed into the proventriculus where it is held until such time as it is regurgitated (Smith and Richmond 1972). The indigestible parts of the prey, such as bone, fur or feathers are covered in a slimy, mucous secretion which helps the bird to regurgitate the pellet (Lloyd and Lloyd 1969). Pellet consistency depends upon what prey has been taken. Large, loose pellets may result from avian prey if a large number of feathers is present in the pellet. The skin and fur from mammalian prey results in a cohesive, strong pellet. Mendelsohn (1989) notes that owl pellets containing invertebrates were far more prone to break up than those containing bone and fur which were more compact, particularly during the rainy season. The break-down of pellets is

exacerbated by moisture and the presence of beetles and other invertebrates. Some 3,665 invertebrates were extracted from 75 Great horned owl pellets, where the invertebrates, particularly the trogid beetles and teneid moths, played a big role in the decomposition of the pellets by feeding on the lipids of feathers and hair (Philips and Dindal 1979).

There is a difference in the efficiency of digestion between old and young owls of the same species and problems may arise when pellets of young birds are mixed with those of older birds on an archaeological site as younger birds have far more thorough, and hence more destructive, digestive systems. The presence of juvenile birds could complicate the identification of the predator at a site. The stronger digestive action of young owls is probably attributable to their need to incorporate bone salts from their prey into their own skeletons (Dodson and Wexlar 1979). A comparison between juvenile and mature owls showed a difference of 51% loss of prey as opposed to a 37% loss in adult birds (Andrews 1990a). Andrews (1990a) notes that his comparison between the roost and nest sites of Barn owls revealed that breakage caused by the juvenile owls at the nest site on the limb bones was 1-22%, as opposed to 1-3% breakage from the roost site where the owls were adults. Skull and mandible breakage was 31-71% for the nest site and 22-25% at the roost site. Digestion of teeth was 3-26% in the juvenile birds and nil in the pellets from adult birds. Pellets deposited in a nest site would be exposed to trampling and breakage by the owls themselves (see chapter 3, section 3.4). Andrews (1990a) notes that the difference of prey loss between adult and juvenile Barn owls is almost as great as the differences he found between the Tawny, Long-eared and Barn owls.

The length of time that a pellet is retained is relevant as, the longer the period a pellet is retained, the more etched the bones become. Regurgitation may take place 8-48 hours after a meal or pellets may be retained for up to five days by birds of prey (Lloyd and Lloyd 1969; Lowe 1980). Not all the bones from an animal may be regurgitated in the same pellet and some may be retained for 24-48 hours before regurgitation (Andrews 1990a). It is interesting to note that, similarly, an investigation of the scats of the White-tailed mongoose showed that parts of single prey individuals could be found in different scats (Andrews and Evans 1983).

Glue (1973) notes that Barn owls may regurgitate a small pellet while hunting and then a larger one later at the nest or roost site. Smith and Richmond (1972) studied the Barn owl and noted that if a second prey item was swallowed within a period of less than 6 hours, it is likely that pellet ingestion would be delayed until the last prey item taken had been digested. If the nights hunting were unsuccessful and there were over six hours between catches of prey it could lead to pellets being regurgitated outside the roost. The above information means that the pellet collection at a roost site may not contain all the prey eaten or all of the bones of an individual prey item. An assortment of diurnal and nocturnal raptors were fed rodents under controlled conditions and it was found that the average interval between eating to pellet regurgitation was 10-13 hours for the owls while the hawk

species averaged 19.5-23.5 hours (Duke *et al.* 1976). Meal to pellet interval (MPI) in the owls appeared to be strongly correlated with quantity of food eaten but the hawks did not show a good correlation (Duke *et al.* 1976). Pellet egestion by owls follows no fixed pattern and is influenced by the length of time since the last meal was consumed, the quantity of food consumed, the availability of the next meal and the sight or capture of prey (Smith and Richmond 1972; Andrews 1990a). At least $6^1/_2$ hours are needed for a pellet to form (Steyn 1984). Hawks are not prevented from eating by the presence of a pellet and the external stimulus of dawn appears to be the factor influencing hawk pellet egestion (Duke *et al.* 1976).

2.1.2 Small carnivore scats

Bothma *et al.* (1976) suggest that a minimum of 94 scats should adequately represent a Black-backed jackal's diet within a 95% confidence limit. Scats may accumulate through the use of latrines, the marking of home ranges or near den entrances (Andrews and Evans 1983). Andrews and Evans (1983) note, somewhat surprisingly, that there appears to be little evidence of puncture marks or gnawed edges on small mammal bone eaten by small carnivores. The canids are the only group that consistently leave tooth marks on the bones of their prey (Andrews 1990a). The degree to which a carnivore digests its prey is influenced by prey age and type, season, and individual variation between individuals of a predator species (Bowland and Bowland 1991).

Different prey items experience differential digestibility thus there is a bias towards the preservation of certain species or body parts (Bowland and Bowland 1991). Also, different body parts of the same prey item take different periods to pass through the digestive system of the predator and one may therefore greatly over-estimate the number of individuals eaten if the assumption is made that the bones from different scats come from different individuals (Bowland and Bowland 1991).

In a study on four Servals and two Black-backed jackals, the animals were fed fixed quantities of rodents and were found to defecate approximately once every 24 hours, but this varied according to how much food had been consumed the previous night (Bowland and Bowland 1991). Both the Servals and the jackals passed out most of one prey item in one or two scats. Parts of the same prey item occurred in an average of 2.8 scats, though one item was found to occur in as many as seven scats (Bowland and Bowland 1991). Few teeth and bones were recovered from the Servals and hair took up to a maximum of seven days to pass through the digestive system. Digestibility appeared to be higher in the jackal and no micromammal teeth were recovered from the male jackal while only 6% were recovered from the female (Bowland and Bowland 1991). Andrews (1990a) has not analysed any Black-backed jackal scats, which leaves a gap in the information available for the potential predators of the microfauna at Elands Bay Cave. However, given the evidence from other small carnivore assemblages and the lack of teeth seen in Bowland and Bowland's (1991) feeding

experiment of the two jackals, it is likely that they would fit in somewhere with the categories of the more destructive predators, as do the species of canids investigated by Andrews (1990a).

2.1.3 Consumption of micromammals by humans

It is difficult to know exactly what to look for on a site if humans were responsible for eating the micromammals. If they were eaten by humans it is likely that the inedible bones would have been dropped or tossed aside during consumption, in this case there should be no evidence of digestion on these bones and teeth. It is not likely that microfaunal bones would be deposited via coprolites as firstly, it appears unlikely that humans would defecate in the cave in which they were living. Secondly, the results of Crandall and Stahl's (1995) investigation of the digestive processes of humans (this is mentioned in some detail below) suggests that the digestive system of humans would cause considerable damage to ingested micromammal bone. These bones would thus have a diminished chance of appearing in the archaeological record if deposited in coprolites.

There is no doubt that rodents were, and indeed still are, an important source of protein to many people. Jerardino *et al.* (1992) recorded the discovery of a c.2700 year old burial of an adult Khoisan female at Groenriviermond, Namaqualand. Postcranial rodent bones were recovered from the ribcage and pelvic bowl, indicating that a rodent had been eaten. The Okavango of Botswana eat large quantities of the Vlei rat, Shaggy swamp rat and Cane rat and the Wanyika of Tanzania catch and eat the Striped field mouse (Avery 1982), despite the fact that it is a small rodent with a mean weight of 36-53g. The molerat is still an important source of protein for many people in the Citrusdal district today, and De Graaff (1981) notes that four or five animals may be eaten by a family in a week, usually in the form of stew.

Some rodents are more easy to trap than others due both to their use of habitat (Nel and Rautenbach 1976) and to behavioural differences. For example, the use of established runways through the bush by some species makes them easy to catch. The Shona people in Zimbabwe make long, cone-shaped traps of grass and sticks (Henderson pers.comm.). These cones have a ring of sticks pointing inwards towards the top of the cone which allows the mouse or rat to pass through the sticks on its way up, but prevents its running out again. These snares are placed on rodent pathways and then the grass around the area is beaten with a stick. This causes the rodents to run out into the snares. The use of snares would mean that both diurnal or nocturnal species of rodent could be caught.

There is an adequate body of information on the effects of diurnal birds of prey, small carnivores and owls on microfauna but very little research has been done on the consumption and digestion of microfauna by humans. Crandall and Stahl (1995) undertook one of the few experiments made in this field when a shrew was fed to an adult human male and the bones removed from the resultant

faeces and examined (Crandall and Stahl 1995). However, this experiment can not be taken to accurately reflect the effects of cooking and consumption in that the shrew was cooked very gently and pieces were swallowed whole, without chewing. When looking at the results of this experiment it should be remembered that the bones were not subjected to the burning, butchering and chewing which humans could subject the animal to prior to ingestion and thus the damage and digestion is probably quite considerably less than it would have been had the shrew been processed more roughly. Only 28 body parts and fragments survived the digestive process and no hip or femoral elements were recovered. There was a complete loss of incisors and all premolars and only a small number of isolated molars were retrieved. There was considerable damage to the skull and only the palatal portions of the maxilla survived, these showed heavy damage to the alveolar borders. The one surviving mandible showed a missing ascending mandibular ramus and inferior border and loss of all but one molar and a fragmented portion of another. The *in situ* molar was less digested than isolated teeth.

Comparison with Andrews (1990a) results are not straightforward as the original number of the shrews body parts are known and in the case of Andrews' calculations his MNIs are under-estimations. Taking this constraint into account, a comparison of the average relative abundance of skeletal elements is uniformly much lower than all of Andrews (1990a) predators which would place humans among the most damaging predators in Andrew's (1990a) classification (see next section) of the different categories of predator (Crandall and Stahl 1995). Comparison between cranial and postcranial proportions and etching of postcranial bones placed the human sample within the range of category 2 modification.

Crandall and Stahl (1995) note that Andrews (1990a) suggested that the preferential destruction of postcranial bones may be due to chewing during consumption, the shrew was ingested without chewing, however, and so the loss of postcranial bones may be attributed to the digestive process alone. In summary then, the experiment suggests that humans cause damage of a degree similar to the more damaging categories of predator listed by Andrews (1990a). The possibility that some of the body parts of micromammals could be discarded during cooking or consumption should also be considered. It is difficult to predict how such bones might appear in the archaeological record, though they would obviously not show any traces of etching.

2.2 Sample accumulation and the interpretation of archaeological assemblages

Avery (1982) notes that rodent population fluctuations may occur every 5 or 8-10 years. Three to four years has also been cited as the period in which many small mammals show a peak in density in

population (Krebs & Myers 1974). Avery (1982) points out that fluctuations never last longer than a decade. The same roost site may be used on and off over a period of hundreds of years and dense accumulations may build up. The long-term trends of such an assemblage can then be linked to palaeoclimatic change. Avery (1990) discusses sampling biases that could be introduced by the Barn owl and mentions that problems, such as over-emphasis of the most common prey species or seasonal variation in prey composition, have been recorded. Avery (1982, 1990) concludes that such small fluctuations are of minor importance as the samples of micromammalian fauna are likely to comprise material accumulated over a period of some hundreds of years and thus short-term fluctuations should not, theoretically, influence the overall trend. It is possible, however, that if the micromammal accumulation was collected over a relatively short period and then preserved in a site, it would give a skewed or incomplete picture of the micromammal population from which it came as it could be reflecting short-term trends or fluctuations (for more information on fluctuations in rodent communities see section 2.5).

At Elands Bay Cave the micromammal remains are relatively scarce and appear in low concentrations as compared to other cave sites such as Steenbokfontein, (a cave site close to Elands Bay on the West coast) (Yates pers. comm.) or Boomplaas (in the southern Cape) (Deacon 1995), where the micromammals appear in dense pockets and probably represent owl accumulations. The largest and most dense units containing micromammals at Elands Bay Cave contain only 25-44 g/m^3 of bone. This paucity of micromammal remains in even the relatively dense units suggests that the micromammal assemblages could have been accumulated over relatively short time periods and raises the issue of whether it is appropriate to assume that short-term trends may be ignored. If the micromammal assemblages at Elands Bay Cave have been accumulated over relatively short periods, the contents of these assemblages may have been influenced by short-term fluctuations in the micromammal community or may be skewed through predator-induced behaviour, thus representing pulses in time rather than long-term averages. An alternate scenario which could explain the small sample sizes at Elands Bay Cave would be if a predator visited the site and left a pellet or scat say, every ten or twenty years. It is impossible to say which scenario is the more accurate in the case of the small samples at Elands Bay Cave. In either case, the results from the analyses done on small samples must be considered unreliable as the information received from such samples is likely to be skewed or incomplete. Small samples are also problematic in that they are biased against rare species (Andrews 1990a). It would appear that indices measuring sample diversity may be affected by sample size, that is, the larger the sample, the greater the diversity (Grayson 1984). Adding small samples together, that may have been deposited in separate periods, for the purposes of analysis may complicate instead of clarify the analysis.

Micromammal populations are by their very nature prone to fluctuations. It has been noted that even studies made of micromammal collections formed over one season can provide only very limited information on population and the relative abundance of species as there may be factors,

such as seasonal fluctuations, influencing the rodent population (Bond *et al.* 1980). The time period in which the archaeological assemblage is laid down may thus prove very relevant in terms of interpretation of the assemblage. Overall trends could be obscured if archaeological assemblages which represented short, time-specific, accumulations were compared with each other, or indeed, with accumulations which had been deposited over a long time period.

2.3 Distinguishing between predators - Andrews' (1990a) results

Andrews (1990a) analysed the breakage patterns, body part representation and the acid etching on the bones and teeth of the microfaunal collections obtained from the scats and pellets of various predators. He looked at tooth loss from the mandibles and maxillae, the number of loose teeth in the different predator assemblages as compared to empty alveolar spaces in the jawbones, the breakage of teeth and of cranial and postcranial bones, and the acid etching on the limb bones and teeth. Using the results he obtained, he was able to show differences between the different categories of predator based on various distinguishing characteristics. Andrews' (1990a) results are tabulated in Appendix 4. Andrews (1990a) studied several European species of owl and small carnivore which are obviously not potential predators of the microfauna at Elands Bay Cave. His results for these European species have been included in Appendix 4 in order to build up a picture of the differences between diurnal birds of prey, owls and small carnivores.

It is possible, using the above methods, to distinguish between the viverrid, the mustelid and canid families generally, but it is more difficult to distinguish within a family (Andrews and Evans 1983, Andrews 1990a). The viverrids are an exception, however, as the bone from the genet scats investigated differed from those of the White-tailed mongoose in that they contained generally more complete bone, whereas the mongoose bones were very broken. The genet assemblage was very severely corroded and rounded and there was destruction of tooth enamel. The mongoose assemblage showed rounding, but not corrosion (Andrews and Evans 1983).

The Bat-eared fox is also an exception as it shows a different pattern to the other canids in that the percentage of etched bones and teeth is much lower, though the bones show the high percentage of breakage that can be seen in other canids. The canids differ from the viverrids in that the bones from their scats show tooth marks and the bone is severely broken. Felids are noted to produce a far greater degree of bone fragmentation and corrosion than any other species (Andrews 1990a). The damage caused by felids is so great that it proved impossible to get a sample of bone large enough to quantify. The mustelids also cause a great amount of damage to their prey and Andrews (1990a) was only able to analyse the contents of scats from a Pine marten as scats from the polecat and stoat failed to yield adequate bone samples for analysis. Scats from otters and mink were found to contain mainly fish and amphibians. The damage caused to the microfaunal assemblages by the diurnal birds of prey was on par with that of the mammalian carnivores.

Andrews (1990a) used a scat collection from the White-tailed mongoose for the purposes of his analysis and when the term 'mongoose' is used, referring to his results, it refers to this species. He notes, however, that the modifications made were very similar to those produced by the Yellow mongoose (Andrews and Evans 1983).

The quantifying of cranial and post-cranial breakage was a central part of Andrews (1990a) analysis. The damage inflicted by the predator during consumption depends on a number of factors and these are mentioned in some detail below.

Andrews (1990a) notes that owls nearly always take prey smaller than themselves whereas diurnal raptors, with their bigger claws and beaks, are able to take much larger prey. Predators usually take prey smaller than themselves, both to avoid injury to themselves and because it makes killing the prey easier (Andrews 1990a). Mammalian carnivores or diurnal birds of prey may hunt co-operatively, thus enabling them to catch larger prey. The relative size of predator to prey, as well as the method with which the predator eats the prey, influences the degree and manner in which the bone gets broken. There is a definite relationship between the amount of damage done during the consumption of a prey item and the size of the predator (Andrews 1990a, 1992). Bones from smaller prey items are generally less corroded and broken than the bones of larger prey animals taken by the same predator as they are less damaged and broken during consumption - larger prey items have to be disaggregated by the predator and chewed more thoroughly during consumption than smaller items. Damaged bones may be less resistant to further damage during digestion than more complete bones. The patterns produced by large carnivores preying on large mammals is comparable to those produced by small carnivores on small mammals (Andrews 1992).
As long as the relative size between predator and prey remains the same, the breakage patterns induced by the different predators is very similar and some elements remain consistently more abundant than others due to their relative robusticity and resistance to the predator's teeth (Andrews and Evans 1983). An investigation of carnivore scats showed that the most consistently common skeletal elements found are the mandible, incisors, femur, tibia and humerus and it was suggested that this reflects their relative strength and resistance to predator damage (Andrews and Evans 1983). In a feeding experiment Dodson & Wexlar (1979) fed mice to the Large great horned owl, the Barn owl and the Screech owl. For all three owls the pelvis and scapula were the most susceptible to damage and the femur, mandible and humerus the least. There was a remarkable similarity in the pattern of relative susceptibility to damage of the various mice bones from the pellets of the different owl species. It would appear that bones tend to break in areas of structural weakness and that different predators produce assemblages with very similar breakage patterns as a result (Andrews 1992). It is thus more informative to quantify how many bones are complete as opposed to those showing breakage, rather than analysing where the bones have been broken. This is particularly true of cave sites where post-depositional breakage is likely to have

obscured the breakage patterns of the bones (Andrews pers. comm.). The acid etching on teeth (particularly the incisors), produced during the digestive process, is thus the most useful indicator to use in tracing the predator. Etching is therefore the most valuable tool in identifying the predator in cases, such as Elands Bay Cave, where there has been post-depositional damage to archaeological assemblages. In the case of Elands Bay Cave, incisor etching and to a lesser degree, completeness of the femur and humerus, proved to be the most useful indicators of predator.

The relative robusticity of certain body parts is further illustrated by the fact that the same breakage patterns and preferential survival of more robust bones have been observed in microfaunal assemblages formed by agents other than small carnivores or birds of prey. The same (robust) body parts are found in microfaunal assemblages formed by harvester ants or in bone assemblages in which the prey bones were deposited intact in the site but were later broken by sediment movement (Andrews and Evans 1983).

Bones that are badly damaged by digestion may have less chance of surviving in the archaeological record. Small carnivores damage their prey far more than owls do and, after passing through the digestive process of a small carnivore, the bones from scats are likely to have been so weakened and damaged that they are not very resistant to stresses such as burial, sediment pressure and trampling (Andrews and Evans 1983). Less than half the bones from prey individuals are found in the scats deposited by small carnivores as much of the bone is lost through consumption and digestion.

There can be variable digestion on bone contained in a single scat and also between the scats of one predator species. It has been suggested that hair from the prey could cover the bone and protect it during digestion in the stomach, thus resulting in patchy digestion (Andrews and Evans 1983). It is this variability in the area of etching that enables the analyst to distinguish between the etching caused by predators and the uniform, widespread etching caused by soil corrosion.

Owls and diurnal predators differ in that there are differences between the two in diet, method of eating and in digestion (Mayhew 1977). Diurnal raptors have strong beaks and necks and tend to tear up and partially consume their prey whereas owls tend to swallow their prey items whole (Lloyd and Lloyd 1969; Glue 1973; Prestt and Wagstaffe 1973). The Barn owl has a higher pH than other birds and digests its prey to a lesser degree than all the other species of owls (Dodson and Wexlar 1979; Avery 1982; Andrews 1990a; Taylor 1994). The diurnal birds of prey generally cause more damage to their prey than the owls, and their pellets often consist of no more than 5-10% of bone due to the destructive nature of their method of consumption and digestion (Andrews 1990a).

Small raptors may consume only a portion of their prey or parents feeding young may feed only parts of prey items to the nestlings and major bones may, in this way, be excluded from the archaeological record if they are discarded away from the nest site. (Glue 1973; Simmons *et al.* 1991). Owls may not feed the heads of prey items to their young, or may eat the head themselves and expel the pellet outside of the roost (Glue 1973; Avery 1982). Such behaviour might greatly decrease the amount of MNIs obtainable from cranial material and examination of both the cranial and postcranial bones would make such behaviour discernible. Taylor (1994) notes that it is as yet unknown how often decapitation takes place. Such a practice could introduce an element of error if pellet analyses were based on cranial counts alone.

Andrews (1990a) looked at the breakage patterns of the cranial bones from the predator assemblages and noted that the percentage of complete mandibles and maxillae in the predator assemblages were similar in rank order and, suprisingly, the more fragile maxillae were only slightly less complete than the mandibles. The least destructive predators, such as the Barn owl and Long-eared owl, caused the least cranial damage and contained the most complete skulls (see Appendix 4, Table 1).

Andrews (1990a) notes that tooth (molar and incisor) loss can be used as an indication of the progressive breaking up of the maxillae and mandibles. Percentage molar loss and percentage incisor loss was thus used by Andrews (1990a) as an indicator to show the destruction and breakage of the jawbones in the predator assemblages as, the more broken the jawbones became, the higher was the percentage of incisors and molars lost. Incisor loss is considered by Andrews (1990a) to be almost uniform for all rodents regardless of taxonomic group, though there are differences in molar loss between voles, lemmings and some cricetids which often have unrooted teeth. There are also differences between murids and other cricetids which have rooted teeth (Andrews 1990a). The predator assemblages fall into almost the same groupings of species for both molar and incisor loss. Incisor loss occurs more readily from premaxillae than from mandibles, however, the rank order of the species in which it occurs is the same. Andrews (1990a) results for tooth loss appear in Appendix 4, Table 2. Andrews (1990a) notes that the grouping that the predators fall into in terms of incisor loss are virtually the same as the groups he obtained when looking at mandibular breakage. The owls showing the highest percentage of maxillary incisor loss are those that showed the greatest damage to the maxilla, namely the Spotted and European eagle owl and the Short-eared owl. Incisor loss is higher in the maxillae than in the mandibles for all the predators. Mandibular molar loss was highest for the small carnivores while the diurnal birds of prey and the Giant eagle owl showed a relatively high percentage of molar loss compared to the other owl species. Maxillary molar loss was not so clear cut, with some overlap between the owls, the diurnal birds of prey and the genet and mongoose.

Andrews (1990a) also compared the number of empty alveoli in the mandibles and maxilla with the number of loose teeth in the assemblage, assuming each mandible and maxilla contained three molars and one incisor. A deficit of isolated teeth could indicate preferential loss of teeth from an assemblage. Surplus teeth could indicate that the bodies of the mandibles and maxillae have been totally destroyed with the teeth alone remaining (Andrews 1990a). If there has been no selection for teeth or jawbones, the numbers of loose teeth should approximate the number of empty alveoli. Andrews (1990a) results for the percentage of isolated teeth may be seen in Appendix 4, Table 3.

Andrews studied the breakage that the different categories of predator caused to both isolated and *in situ* teeth (See Appendix 4, Table 4). He notes that, generally, the predators that show little damage to the incisors and molars are those that cause little damage to the jawbones. The small carnivores cause considerably more damage to loose as opposed to *in situ* teeth. Andrews notes that the breakage caused by the small carnivores is considerably greater than that caused by avian predators and is thus easily distinguishable. He also notes that splitting of the molar crowns is characteristic of the mammalian carnivores, particularly the mongoose and pine marten.

Selection for (or against) proximal, as opposed to distal, elements was checked by dividing the number of tibiae and radii by the number of femora and humeri and calculating the percentage (Andrews 1990a). The proportions of post-cranial to cranial elements was also calculated to see if there had been preferential selection or damage against either group by dividing the total number of humeri and femora by the number of mandibles plus maxillae (for these results see Appendix 4, Table 5). The Barn owl; Long-eared owl, European eagle owl and Great grey owl all showed results which indicated fairly equal numbers of postcranial and cranial elements. The Short-eared owl assemblage indicated a suprisingly high proportion of postcrania. Andrews attributes the high values shown by the Snowy owl, red fox, mongoose and coyote to the decapitation of prey prior to consumption. The pellets of the Giant and Spotted eagle owls, kestrel, hen harrier and Tawny owl showed a deficiency of postcrania. Andrews' (1990a) results showed that the various owl species showed little preferential loss of distal elements, with the exception of the spotted eagle owl which showed a high percentage of distal limb loss. The small carnivores also showed a high loss of distal elements as did the Hen harrier. The Kestrel showed a greater loss than the owls (excluding the Spotted eagle owl) but fell closer to the coyote and red fox rather than the other diurnal birds of prey.

The breakage of the main long bones from the various predator assemblages was recorded by Andrews (1990a) and may be seen in Appendix 2, Table 6. Andrews (1990a) used these results to divide the predators into three different classes - firstly, the typical owls which are the least destructive and show the highest levels of completeness; the Barn owl, Long-eared owl, Short-eared owl, Great grey owl and Giant eagle owl. These owls show generally high proportions of cranial and postcranial elements and low proportions of isolated teeth. The second category is that of the intermediate owls, the Spotted eagle owl and Tawny owl, which show an uneven skeletal

element representation and break the bones to a moderate degree. The third, fourth and fifth categories contain the diurnal raptors and small carnivores which create the maximum amount of damage and show low relative abundances of the more fragile bones.

Table 2.2: The division of predators into categories as listed by Andrews (1990a)

Predator categories					
	1	2	3	4	5
Breakage of skulls	BO, SO, LE, GEO , GGO	SE, SPEO, EEO, T	LIT, KES, H	-	MAM. CARN.
Breakage of mandibles	BO, LE, GEO , GGO	SO, SE, EEO, T	SPEO, KES, H	LIT, MAM. CARN.	-
Mandibular tooth loss	BO, SO, LE, SE, GGO, EEO	GEO , SPEO, T	LIT, KES, COY, ART, PINE	H, MONG, GEN, BAT, RED	-
Maxillary tooth loss	BO, SO, LE, GEO ,	GGO, T	SE, EEO, SPEO, BAT FOX COY	LIT, KES, H GEN, MONG, RED, ART, PINE	-
Proportions isolated teeth	BO, SO, LE, SE, GEO, EEO, SPEO	GGO, COY, MONG	T, LIT, BAT-EARED	KES, GEN, RED, PINE	H, ART,
Postcranial/ cranial proportions	BO, LE, SE, EEO, GGO, PINE, BAT	T, GEO , SPEO, KES, GEN	H, ART,	SO, LIT, MONG, COY, RED	-
Loss of distal elements of postcrania	BO, SO, LE, GEO , T	SE, EEO, GGO, COY, ART	LIT, KES	SPEO, H, RED	PINE, MONG, GEN, BAT
Breakage of teeth	BO, SO, LE, GGO,	SE, GEO , SPEO, LIT	EEO, T	KES, H	MAM. CARN.
Incisor digestion	BO, SE, SO	LE, GEO , BAT, GGO	EEO, SPEO, T, LIT, PINE, MONG, GEN	KES	H, ART, RED, COY
Breakage of postcrania	BO, GGO, LE, SE, GEO	SO, EEO	SPEO, T,	LIT, KES, H, MONG, GEN, BAT	PINE, ART, RED, COY

(After Andrews 1990a:Table 3.16)

Key: BO=Barn owl, SO=Snowy owl, LE=Long-eared owl, SE=Short-eared owl, GEO=Giant eagle owl, SPEO=Spotted eagle owl, EEO=European eagle owl, GG=Great grey owl, T=Tawny owl, LIT=Little owl, COY=Coyote, BAT=Bat-eared fox, PINE=Pine Marten, H=Hen Harrier, ART=Artic fox, MONG=Mongoose, GEN=Genet, KES=Kestrel, RED=Red Fox, MAM. CARN.=Mammalian Carnivores

Andrews (1990a) notes that the distal humerus and proximal tibia and femur are preferentially preserved in the assemblages formed by the most destructive predators, while the less destructive species show no such trend. In terms of completeness, there is a big difference between the owls (excluding the little owl which causes a lot of damage) and the diurnal birds of prey and small carnivores. The owls, excluding the little owl, generally caused less damage to the long bones than the small carnivores or diurnal birds of prey. Table 2.2 summarises the different measurements of breakage and tooth loss used by Andrews (1990a) and shows how these divide the various predators into the different categories. The least damaging predators are found in category one, the slightly more destructive predators in category two and so on, with category five containing the most destructive predators. Table 2.3 follows table 2.2 and summarises the incisor digestion categories that the various predator assemblages fell into in terms of the percentage of etched incisors. Where breakage is not definitive, the etching observed on the upper and lower incisors may provide a conclusive indication of the category or even the species of the predator. The percentage of incisors showing evidence of etching proved the most crucial factor in the identification of the predator/s at Elands Bay Cave. Table 2.4 summarises the groupings that the

such as seasonal fluctuations, influencing the rodent population (Bond *et al.* 1980). The time period in which the archaeological assemblage is laid down may thus prove very relevant in terms of interpretation of the assemblage. Overall trends could be obscured if archaeological assemblages which represented short, time-specific, accumulations were compared with each other, or indeed, with accumulations which had been deposited over a long time period.

2.3 Distinguishing between predators - Andrews' (1990a) results

Andrews analysed the breakage patterns, body part representation and the acid etching on the bones and teeth of the microfaunal collections obtained from the scats and pellets of various predators. He looked at tooth loss from the mandibles and maxillae, the number of loose teeth in the different predator assemblages as compared to empty alveolar spaces in the jawbones, the breakage of teeth and of cranial and postcranial bones, and the acid etching on the limb bones and teeth. Using the results he obtained, he was able to show differences between the different categories of predator based on various distinguishing characteristics. Andrews' results are tabulated in Appendix 4. Andrews studied several European species of owl and small carnivore which are obviously not potential predators of the microfauna at Elands Bay Cave. His results for these European species have been included in Appendix 4 in order to build up a picture of the differences between diurnal birds of prey, owls and small carnivores.

It is possible, using the above methods, to distinguish between the viverrid, the mustelid and canid families generally, but it is more difficult to distinguish within a family (Andrews and Evans 1983, Andrews 1990a). The viverrids are an exception, however, as the bone from the genet scats investigated differed from those of the White-tailed mongoose in that they contained generally more complete bone, whereas the mongoose bones were very broken. The genet assemblage was very severely corroded and rounded and there was destruction of tooth enamel. The mongoose assemblage showed rounding, but not corrosion (Andrews and Evans 1983).

The Bat-eared fox is also an exception as it shows a different pattern to the other canids in that the percentage of etched bones and teeth is much lower, though the bones show the high percentage of breakage that can be seen in other canids. The canids differ from the viverrids in that the bones from their scats show tooth marks and the bone is severely broken. Felids are noted to produce a far greater degree of bone fragmentation and corrosion than any other species. The damage caused by felids is so great that it proved impossible to get a sample of bone large enough to quantify. The mustelids also cause a great amount of damage to their prey and Andrews was only able to analyse the contents of scats from a Pine marten as scats from the polecat and stoat failed to yield adequate bone samples for analysis. Scats from otters and mink were found to contain mainly fish and amphibians. The damage caused to the microfaunal assemblages by the diurnal birds of prey was

on par with that of the mammalian carnivores. Andrews used a scat collection from the White-tailed mongoose for the purposes of his analysis and when the term 'mongoose' is used, referring to his results, it refers to this species. He notes, however, that the modifications made were very similar to those produced by the Yellow mongoose (Andrews and Evans 1983).

The quantifying of cranial and post-cranial breakage was a central part of Andrews analysis. The damage inflicted by the predator during consumption depends on a number of factors and these are mentioned in some detail below.

Andrews notes that owls nearly always take prey smaller than themselves whereas diurnal raptors, with their bigger claws and beaks, are able to take much larger prey. Predators usually take prey smaller than themselves, both to avoid injury to themselves and because it makes killing the prey easier. Mammalian carnivores or diurnal birds of prey may hunt co-operatively, thus enabling them to catch larger prey. The relative size of predator to prey, as well as the method with which the predator eats the prey, influences the degree and manner in which the bone gets broken. There is a definite relationship between the amount of damage done during the consumption of a prey item and the size of the predator (Andrews 1990a, 1992). Bones from smaller prey items are generally less corroded and broken than the bones of larger prey animals taken by the same predator as they are less damaged and broken during consumption - larger prey items have to be disaggregated by the predator and chewed more thoroughly during consumption than smaller items. Damaged bones may be less resistant to further damage during digestion than more complete bones. The patterns produced by large carnivores preying on large mammals is comparable to those produced by small carnivores on small mammals (Andrews 1992).

As long as the relative size between predator and prey remains the same, the breakage patterns induced by the different predators is very similar and some elements remain consistently more abundant than others due to their relative robusticity and resistance to the predator's teeth (Andrews and Evans 1983). An investigation of carnivore scats showed that the most consistently common skeletal elements found are the mandible, incisors, femur, tibia and humerus and it was suggested that this reflects their relative strength and resistance to predator damage (Andrews and Evans 1983). In a feeding experiment Dodson & Wexlar (1979) fed mice to the Large great horned owl, the Barn owl and the Screech owl. For all three owls the pelvis and scapula were the most susceptible to damage and the femur, mandible and humerus the least. There was a remarkable similarity in the pattern of relative susceptibility to damage of the various mice bones from the pellets of the different owl species. It would appear that bones tend to break in areas of structural weakness and that different predators produce assemblages with very similar breakage patterns as a result (Andrews 1992). It is thus more informative to quantify how many bones are complete as opposed to those showing breakage, rather than analysing where the bones have been broken. This

is particularly true of cave sites where post-depositional breakage is likely to have obscured the breakage patterns of the bones (Andrews pers. comm.). The acid etching on teeth (particularly the incisors), produced during the digestive process, is thus the most useful indicator to use in tracing the predator. Etching is therefore the most valuable tool in identifying the predator in cases, such as Elands Bay Cave, where there has been post-depositional damage to archaeological assemblages. In the case of Elands Bay Cave, incisor etching and to a lesser degree, completeness of the femur and humerus, proved to be the most useful indicators of predator.

The relative robusticity of certain body parts is further illustrated by the fact that the same breakage patterns and preferential survival of more robust bones have been observed in microfaunal assemblages formed by agents other than small carnivores or birds of prey. The same (robust) body parts are found in microfaunal assemblages formed by harvester ants or in bone assemblages in which the prey bones were deposited intact in the site but were later broken by sediment movement (Andrews and Evans 1983).

Bones that are badly damaged by digestion may have less chance of surviving in the archaeological record. Small carnivores damage their prey far more than owls do and, after passing through the digestive process of a small carnivore, the bones from scats are likely to have been so weakened and damaged that they are not very resistant to stresses such as burial, sediment pressure and trampling (Andrews and Evans 1983). Less than half the bones from prey individuals are found in the scats deposited by small carnivores as much of the bone is lost through consumption and digestion.

There can be variable digestion on bone contained in a single scat and also between the scats of one predator species. It has been suggested that hair from the prey could cover the bone and protect it during digestion in the stomach, thus resulting in patchy digestion (Andrews and Evans 1983). It is this variability in the area of etching that enables the analyst to distinguish between the etching caused by predators and the uniform, widespread etching caused by soil corrosion.

Owls and diurnal predators differ in that there are differences between the two in diet, method of eating and in digestion (Mayhew 1977). Diurnal raptors have strong beaks and necks and tend to tear up and partially consume their prey whereas owls tend to swallow their prey items whole (Lloyd and Lloyd 1969; Glue 1973; Prestt and Wagstaffe 1973). The Barn owl has a higher pH than other birds and digests its prey to a lesser degree than all the other species of owls (Dodson and Wexlar 1979; Avery 1982; Andrews 1990a; Taylor 1994). The diurnal birds of prey generally cause more damage to their prey than the owls, and their pellets often consist of no more than 5-10% of bone due to the destructive nature of their method of consumption and digestion (Andrews 1990a).

Small raptors may consume only a portion of their prey or parents feeding young may feed only parts of prey items to the nestlings and major bones may, in this way, be excluded from the archaeological record if they are discarded away from the nest site. (Glue 1973; Simmons *et al.* 1991). Owls may not feed the heads of prey items to their young, or may eat the head themselves and expel the pellet outside of the roost (Glue 1973; Avery 1982). Such behaviour might greatly decrease the amount of MNIs obtainable from cranial material and examination of both the cranial and postcranial bones would make such behaviour discernible. Taylor (1994) notes that it is as yet unknown how often decapitation takes place. Such a practice could introduce an element of error if pellet analyses were based on cranial counts alone.

Andrews looked at the breakage patterns of the cranial bones from the predator assemblages and noted that the percentage of complete mandibles and maxillae in the predator assemblages were similar in rank order and, suprisingly, the more fragile maxillae were only slightly less complete than the mandibles. The least destructive predators, such as the Barn owl and Long-eared owl, caused the least cranial damage and contained the most complete skulls (see Appendix 4, Table 1).

Andrews notes that tooth (molar and incisor) loss can be used as an indication of the progressive breaking up of the maxillae and mandibles. Percentage molar loss and percentage incisor loss was thus used by Andrews as an indicator to show the destruction and breakage of the jawbones in the predator assemblages as, the more broken the jawbones became, the higher was the percentage of incisors and molars lost. Incisor loss is considered by Andrews to be almost uniform for all rodents regardless of taxonomic group, though there are differences in molar loss between voles, lemmings and some cricetids which often have unrooted teeth. There are also differences between murids and other cricetids which have rooted teeth. The predator assemblages fall into almost the same groupings of species for both molar and incisor loss. Incisor loss occurs more readily from premaxillae than from mandibles, however, the rank order of the species in which it occurs is the same. Andrews results for tooth loss appear in Appendix 4, Table 2. Andrews notes that the grouping that the predators fall into in terms of incisor loss are virtually the same as the groups he obtained when looking at mandibular breakage. The owls showing the highest percentage of maxillary incisor loss are those that showed the greatest damage to the maxilla, namely the Spotted and European eagle owl and the Short-eared owl. Incisor loss is higher in the maxillae than in the mandibles for all the predators. Mandibular molar loss was highest for the small carnivores while the diurnal birds of prey and the Giant eagle owl showed a relatively high percentage of molar loss compared to the other owl species. Maxillary molar loss was not so clear cut, with some overlap between the owls, the diurnal birds of prey and the genet and mongoose.

Andrews also compared the number of empty alveoli in the mandibles and maxilla with the number of loose teeth in the assemblage, assuming each mandible and maxilla contained three molars and

one incisor. A deficit of isolated teeth could indicate preferential loss of teeth from an assemblage. Surplus teeth could indicate that the bodies of the mandibles and maxillae have been totally destroyed with the teeth alone remaining. If there has been no selection for teeth or jawbones, the numbers of loose teeth should approximate the number of empty alveoli. Andrews results for the percentage of isolated teeth may be seen in Appendix 4, Table 3.

Andrews studied the breakage that the different categories of predator caused to both isolated and *in situ* teeth (See Appendix 4, Table 4). He notes that, generally, the predators that show little damage to the incisors and molars are those that cause little damage to the jawbones. The small carnivores cause considerably more damage to loose as opposed to *in situ* teeth. Andrews notes that the breakage caused by the small carnivores is considerably greater than that caused by avian predators and is thus easily distinguishable. He also notes that splitting of the molar crowns is characteristic of the mammalian carnivores, particularly the mongoose and pine marten.

Selection for (or against) proximal, as opposed to distal, elements was checked by dividing the number of tibiae and radii by the number of femora and humeri and calculating the percentage. The proportions of post-cranial to cranial elements was also calculated to see if there had been preferential selection or damage against either group by dividing the total number of humeri and femora by the number of mandibles plus maxillae (for these results see Appendix 4, Table 5). The Barn owl, Long-eared owl, European eagle owl and Great grey owl all showed results which indicated fairly equal numbers of postcranial and cranial elements. The Short-eared owl assemblage indicated a suprisingly high proportion of postcrania. Andrews attributes the high values shown by the Snowy owl, red fox, mongoose and coyote to the decapitation of prey prior to consumption. The pellets of the Giant and Spotted eagle owls, kestrel, hen harrier and Tawny owl showed a deficiency of postcrania. Andrews' results showed that the various owl species showed little preferential loss of distal elements, with the exception of the spotted eagle owl which showed a high percentage of distal limb loss. The small carnivores also showed a high loss of distal elements as did the Hen harrier. The Kestrel showed a greater loss than the owls (excluding the Spotted eagle owl) but fell closer to the coyote and red fox rather than the other diurnal birds of prey.

The breakage of the main long bones from the various predator assemblages was recorded by Andrews and may be seen in Appendix 2, Table 6. Andrews used these results to divide the predators into three different classes - firstly, the typical owls which are the least destructive and show the highest levels of completeness; the Barn owl, Long-eared owl, Short-eared owl, Great grey owl and Giant eagle owl. These owls show generally high proportions of cranial and postcranial elements and low proportions of isolated teeth. The second category is that of the intermediate owls, the Spotted eagle owl and Tawny owl, which show an uneven skeletal element

representation and break the bones to a moderate degree. The third, fourth and fifth categories contain the diurnal raptors and small carnivores which create the maximum amount of damage and show low relative abundances of the more fragile bones.

Table 2.2: The division of predators into categories as listed by Andrews (1990a)

	Predator categories				
	1	2	3	4	5
Breakage of skulls	BO, SO, LE, GEO , GGO	SE, SPEO, EEO, T	LIT, KES, H	-	MAM. CARN.
Breakage of mandibles	BO, LE, GEO , GGO	SO, SE, EEO, T	SPEO, KES, H	LIT, MAM. CARN.	-
Mandibular tooth loss	BO, SO, LE, SE, GGO, EEO	GEO , SPEO, T	LIT, KES, COY, ART, PINE	H, MONG, GEN, BAT, RED	-
Maxillary tooth loss	BO, SO, LE, GEO ,	GGO, T	SE, EEO, SPEO, BAT FOX COY	LIT, KES, H GEN, MONG, RED, ART, PINE	-
Proportions isolated teeth	BO, SO, LE, SE, GEO, EEO, SPEO	GGO, COY, MONG	T, LIT, BAT-EARED	KES, GEN, RED, PINE	H, ART,
Postcranial/ cranial proportions	BO, LE, SE, EEO, GGO, PINE, BAT	T, GEO , SPEO, KES, GEN	H, ART,	SO, LIT, MONG, COY, RED	-
Loss of distal elements of postcrania	BO, SO, LE, GEO , T	SE, EEO, GGO, COY, ART	LIT, KES	SPEO, H, RED	PINE, MONG, GEN, BAT
Breakage of teeth	BO, SO, LE, GGO,	SE, GEO , SPEO, LIT	EEO, T	KES, H	MAM. CARN.
Incisor digestion	BO, SE, SO	LE, GEO , BAT, GGO	EEO, SPEO, T, LIT, PINE, MONG, GEN	KES	H, ART, RED, COY
Breakage of postcrania	BO, GGO, LE, SE, GEO	SO, EEO	SPEO, T,	LIT, KES, H, MONG, GEN, BAT	PINE, ART, RED, COY

(After Andrews 1990a:Table 3.16)

Key: BO=Barn owl, SO=Snowy owl, LE=Long-eared owl, SE=Short-eared owl, GEO=Giant eagle owl, SPEO=Spotted eagle owl, EEO=European eagle owl, GG=Great grey owl, T=Tawny owl, LIT=Little owl, COY=Coyote, BAT=Bat-eared fox, PINE=Pine Marten, H=Hen Harrier, ART=Artic fox, MONG=Mongoose, GEN=Genet, KES=Kestrel, RED=Red Fox, MAM. CARN.=Mammalian Carnivores

Andrews notes that the distal humerus and proximal tibia and femur are preferentially preserved in the assemblages formed by the most destructive predators, while the less destructive species show no such trend. In terms of completeness, there is a big difference between the owls (excluding the little owl which causes a lot of damage) and the diurnal birds of prey and small carnivores. The owls, excluding the little owl, generally caused less damage to the long bones than the small carnivores or diurnal birds of prey. Table 2.2 summarises the different measurements of breakage and tooth loss used by Andrews and shows how these divide the various predators into the different categories. The least damaging predators are found in category one, the slightly more destructive predators in category two and so on, with category five containing the most destructive predators. Table 2.3 follows table 2.2 and summarises the incisor digestion categories that the various predator assemblages fell into in terms of the percentage of etched incisors. Where breakage is not definitive, the etching observed on the upper and lower incisors may provide a conclusive indication of the category or even the species of the predator. The percentage of incisors showing evidence of etching proved the most crucial factor in the identification of the predator/s at Elands

Bay Cave. Table 2.4 summarises the groupings that the predators were divided into by Andrews on the basis of the percentage of incisors etched in the various predator assemblages.

Table 2.3: Predator categories as determined by the percentage of digested incisors

Predator category	Percentage of incisor digestion
Category 1: Barn owl, Short-eared owl, Snowy owl	Digestion minimal or absent altogether Incisor % etched = 8 - 13%
Bat-eared fox - intermediate	Light digestion Incisor % etched =19%
Category 2: Long-eared owl, Giant eagle owl, Great grey owl	Moderate digestion Incisor % etched = 20 - 30%
Mustelids: (intermediate between categories 2 and 3)	% incisors etched is low, but etching is heavier than most category 2 predators Incisor % etched = 24%
Viverrids: (intermediate between categories 2 and 3	Incisor % etched = 34-40%
Category 3: Tawny owl and little owl, European & Spotted eagle owls	Heavy digestion Incisor % etched = 50 - 70%
Category 4: Kestrels and Peregrines	Extreme digestion Incisor % etched = 60 - 80%
Canids: (intermediate, may fall into category 4 or 5) Coyote, red fox, artic fox	Extreme digestion Incisor % etched = 70 - 100%
Category 5: Buzzards, Kites, Hen Harrier	Extreme digestion Incisor % etched =100%
Felids: (there were no samples analysed for this species as most of the bones and teeth were destroyed)	Extreme digestion

(After Andrews 1990a:Table 3.14 and Andrews 1990a:page 75)

The Bat-eared fox is something of an anomaly in that, though it is one of the most destructive predators as regards cranial and postcranial breakage, it shows a low percentage of incisor etching. To summarise the results in Tables 2.2 and 2.3, the owls are generally less destructive to the bones of their prey than the diurnal birds of prey and the mammalian carnivores. The bones from the assemblages of the more damaging predators thus contain bones and teeth which are more broken and etched than those from the owls such as the Barn owl, Long-eared owl, Short-eared owl, Great grey owl, and Giant eagle owl, which show what Andrews calls the 'typical owl' pattern. Of all the predators, the Barn owl etches and damages the bones of its prey the least.

2.4 The relationship between predator and prey

The following sections introduce some of the factors which influence the relationship between predator and prey, especially as regards the selection of prey by the predator. This information is included because it has a direct bearing on what species end up being represented in fossil archaeological assemblages and the biases that may be introduced by predators. Cruz-Uribe (1988) notes that the diversity and richness of a fossil faunal assemblage is greatly influenced by both the environment in which it accumulated, and the behaviour of the predator. This section tries to give a clearer picture of how predator behaviour could affect the species representation in archaeological assemblages. Analyses of archaeological assemblages in South Africa have been based on the assumption that the predator was the Barn owl (Avery 1981; 1982, 1987, 1990, 1992), which hunts a broad sample (within a certain size range) of the micromammals in its hunting range. As a result of this assumption of the Barn owl as predator, little emphasis has been placed on the role played by the actual predator in the selection of prey species.

This section introduces some of the variables which may lead to a certain sample of species occurring in an archaeological assemblage as a result of predator, or prey, behaviour. The nature of the relationship between the size of the predator and the prey is complicated by factors such as differences in hunting behaviour and reactions to prey availability on the part of the predator (Andrews 1990a). The prey variability in an archaeological sample is thus a reflection of the species of predator involved, the choices made by that predator, and the choices open to the predator in terms of the available rodent population. Variation in an archaeological micromammal assemblage in the mean size of the individuals of a species, in diversity, or changes in the composition of the micromammal community may be attributable to any of a number of causes, namely;

- changes in the identity of the predator
- changes in predator behaviour with regard to the selection of prey species (for example, seasonal changes in diet)
- changes within the rodent community in which the predator hunts
- environmental change.

2.4.1 Selection of prey

The main issues relating to predator behaviour and selection of prey are listed below.

Some predators are more selective than others and are, therefore, more likely to present more skewed micromammal assemblages in terms of the available rodent population from which they select their prey. The Tawny owl, eagle owls, Barn owl, Short-eared owl and buzzards adapt their diet according to the most available prey (Andrews 1990a) and are therefore not specific eaters. Their diet would most likely consist of the most common prey species in an area. The Long-eared owls show a different prey size spectrum from the Barn or Tawny owls which hunt in the same geographical region (Andrews 1990a). Virtually all of the Barn owl's main prey species share one important characteristic - their numbers vary greatly with season and from year to year (Taylor 1994). Certain predators, on the other hand, are fairly specialised hunters and will take a specific prey species even if other species are more available (Andrews 1990a). This should be taken into account when rodent diversity studies are made, particularly in areas of semi-desert, desert or erratic rainfall as density and diversity in the same biotic region, some 120 km apart, may vary greatly (Nel and Rautenbach 1975).

Birds of prey which are specific feeders and depend on one or two prey species travel around and seek high population densities of such prey (Mendelsohn 1982b). Mammalian predators are less mobile than avian predators and are more likely to remain within an area when prey numbers drop. Conversely, populations of predators which are more generalist feeders remain constant (Krebs

and Myers 1974). Some raptors such as the Snowy owl, Rough-legged hawk and White-tailed kite are so influenced by the availability of prey that they are only able to breed when the prey population is relatively high (Krebs and Myers 1974). Likewise, a decrease in breeding of the Barn owl was observed when low rainfall resulted in a decrease in the breeding of prey species (Steyn 1984).

In a study done by Andrews (1990a), it was found that the most common rodent in an area was the predominant species found in the Barn owl pellets, whereas the pellets of the Giant eagle owl from the same area yielded none of this species. This difference was attributed to the more nocturnal activity of the Barn owl. It should be remembered that different behaviour patterns of predators and prey can result in a prey species not appearing in the archaeological record. The habits of a prey species can thus sometimes be used to rule out potential predators which have opposite activity patterns. A predator may live in one habitat but hunt in another and thus the micromammals found at the roost site will not reflect the micromammal population living in the vicinity of the roost (Scott *et al.* 1996).

Taylor (1994) notes a trend in Barn owl predation with Barn owls having narrower and more specialised diets in more productive habitats, and a wider spectrum diet in areas that are more arid and have lower micromammal densities. Predator behaviour such as this has important implications when species diversity is used in the extrapolation of palaeoclimates. Giller (1984) notes that it has been clear for a long time that there is some correlation between harshness of climate and decreased species diversity. The danger is that reduced diversity in an archaeological assemblage be linked to deterioration in environment or changes in climate, whereas in actual fact they are reflecting nothing more than predator behaviour.

A seasonally related change in prey has been noted in mammalian predators as well as in birds of prey (Berry 1981; Mendelsohn 1982b; Taylor 1994). Certain owl species, for example, switch from a diet of rodents during the winter, to insects and birds during the summer as it is difficult to catch rodents in the long grass (Andrews 1990a).

Fluctuations in the population of micromammals will influence the food supply available to the predator, which will react accordingly. A prey species may attract a predator because of its size, palatability or simply availability (Andrews and Evans 1983). Prey selection depends on the feeding habits of the predator and the degree of specialization, as well as on the relative vulnerability of the prey species (Andrews and Evans 1983). Taylor (1994) notes that predators can more easily locate prey which is active and on the move, thus the activity patterns of potential prey species may play an important role in determining their relative availability. This is suggested because when a comparison was made between the sex and weight classes of voles caught by owls and the population found in the wild, it appeared that the owls were selecting large, male voles from the population (Taylor 1994). This could be attributable to the greater

territoriality of male, as opposed to female voles, and their resulting increased mobility, thus making them more vulnerable to predation (Taylor 1994). Differences in the diet of male and female rodents could also result in one sex becoming more prone to predation. Selection on the part of the predator for a particular size (or sex) of a prey species may result in a collection of pellets which do not reflect the actual available size range of individuals of that species and which give an artificially big or small mean size for that species. Behaviour such as this could greatly complicate interpretation of the archaeological record and could lead to changes in mean size being mistakenly attributed to palaeoenvironmental causes.

2.4.2 The influence of sex and breeding status of predators on prey choice

The raptors often show a large degree of dimorphism with the females being larger than the males. In some of the raptor species showing sexual dimorphism the different sexes take, on the average, different sized prey (Amadon 1975; Mendelsohn 1986). It would appear that, at the same time of year, consumption of both the amount of prey as well as the prey species taken may differ greatly between the sexes. Breeding appears to create a difference between the weight and food consumption of male and female birds of prey (Lowe 1980). During the breeding season of Greater kestrels the hunting roles of the sexes become separated with the male provisioning the female during courtship, incubation and rearing of the young (Kemp 1995). Paired Blackshouldered kites were found to catch more diurnal prey than unpaired birds (Mendelsohn 1982b) and the diet of the Greater Kestrel was found to vary greatly from incubation, when 73% of the prey delivered to the female by the male was composed of invertebrates, to when feeding chicks when invertebrates composed only 13% of diet. When the birds were single, less than 6% of prey was composed of invertebrates (Kemp and Filner 1989). The breeding females of the Barn owl, buzzard, Tawny owl and Long-eared owl all reach peak body weights during the breeding season when they are egg-laying while the males are at their lightest weight (Dean 1973). It has been noted that there were significantly fewer bones lost in the pellets produced by nesting females than the pellets from the males (Lowe 1980). The level of acidity in the stomach and the length of time the food is retained determine the degree of bone modification and etching caused by the predator (Lowe 1980; Andrews 1990a). It also appears that the sex of the bird or the season could also affect the degree to which the bones are digested. This in turn may affect their ability to survive in the archaeological record.

A factor that should be remembered when analysing an archaeological micromammal assemblage is that different species of micromammals or different age animals appear to be affected by digestion in varying degrees. Lowe (1980) looked at the skulls of micromammals regurgitated in the Tawny owl pellets and noted that the species with more fragile skulls lost a higher percentage of bones. Woodmice and Bank voles showed a significant loss of skull bones at times of year when these species were breeding and there was a large number of young being consumed (Lowe

1980). In an experiment in which mice were fed to seven species of raptorial birds, the relative representation of cranial material varied markedly with slight differences in the ages of the mice (Hoffman 1988). Thus, the sex and age of the predator, its breeding status, the season and the prey (the age and the species thereof) taken are all factors which may influence the bones appearing in the pellets and the degree of etching observed. It has been noted that amphibian bones are not always able to withstand the digestive powers of owls and may therefore be under-represented in owl pellets (Goodman *et al.* 1993). Juvenile animals could possibly have a decreased chance of surviving in the archaeological record as, firstly, they would be more prone to damage during consumption and secondly, the size and relative weakness of the bones may affect their ability to survive in the archaeological record.

2.4.3 Mean size and predator selection

Klein and Cruz-Uribe (1984) note that studies of changes in mean individual size are artificial in that mean individual size, species abundance and age/sex composition are treated as if they were separate from one another, whereas they are very much linked. Many palaeoenvironmental extrapolations do not take sexual dimorphism or age of individuals into account. This problem is acknowledged by Avery (1982) who notes that a variation in mean individual size of a species could reflect differences in the age or the sex of the animals in the sample rather than climatic change. This possibility is especially relevant as there is evidence that predators often select certain size/age categories of prey. If size selection on the part of the predator is not taken into account, the presence of younger, and hence smaller, individuals may be wrongly interpreted as being indicative of a decrease in the mean size of the individuals of that species. This issue has not been dealt with satisfactorily in many of the palaeoenvironmental analyses done on micromammals in South Africa.

The Barn owl, which preys on the most abundant small mammal species, is capable of adapting to different sized prey, though there is an upper and lower limit to the size of prey it takes (see Appendix 3). Studies on the multimammate mouse in South Africa, which is often a major prey item of Barn owls, have shown that there was a selection by Barn owls for the younger age classes of this species (Taylor 1994). In another study of Barn owl diet it was found that the owls selected only 25% of the entire size range of a certain species, with predominantly younger, and smaller, rodents being preyed upon (Morris 1979). This means that the portion of the population preyed upon by the owls was not representative of the entire size or age range available. Palaeoenvironmental extrapolations often involve calculations which use the mean size of the individuals of a species. Such calculations would be incorrect if behaviour such as size selection on the part of the predator was not accounted for. For example, if the mean mass of a species was taken to be 100g and this was taken to represent 5 prey units, the actual contribution of a rat would be far less, perhaps 3 prey units, if the owl were selecting the majority of his prey from the smaller

size spectrum of available animals. This means that the prey unit value of a species may vary according to the predator which is hunting them. In a study of Barn owl diets in New Jersey, rats of up to 90g made up just over a quarter of the wild population available to the owl, yet 63% of the rodents caught came from this size group. Dodson and Wexlar (1979) write that Barn owls take 95% and Screech Owls 83% of their prey in the mouse size range. Perrin (1982) found that the Barn owl took prey within a range of 9 - 100g, and appeared to avoid taking any really small species. However, other studies have shown no selection of particular age or size categories so no hard and fast conclusions may be drawn (Taylor 1994).

During the breeding season of the Striped mouse only about 8% of the population is older than 25 weeks of age (Henschel *et al.* 1982). Any predator taking mice from this population would be taking a large proportion of very young animals. An analysis of a micromammal assemblage accumulated during this breeding period would thus give an artificially low mean size for the Striped mouse.

Taylor (1994) notes that it appears that there is some fundamental relationship between the weight of prey and predator as many bird and mammal predators take prey equivalent to 10% of their body weight. It would appear that of the range of prey available, a predator may specifically select for prey of a certain size range. If such selection is taking place it may prove extremely important when looking at changes in mean size over time in a micromammal fossil assemblage, especially if the archaeological deposits have been formed by more than one predator. The variability of factors affecting prey size means that prey size spectra can only be used very generally and cannot be used to trace the predator type.

2.4.4 The hunting methods used by birds of prey

The hunting behaviour of the predator influences the species of prey that it is able to catch. Taylor (1994) notes a change in the hunting methods used by the Barn owl during the breeding season Breeding owls chose a hunting method (that of flight hunting) which is costly in terms of energetic output but yields high returns, as opposed to the lower return, but more energy conserving, perch hunting. A change in hunting methods may lead to changes in the prey species taken. Table 2.4 summarises the hunting methods used by the various birds of prey.

Table 2.4: Hunting behaviour of the birds of prey

Species	Hunting behaviour	Method of prey capture
Barn owl	Selective, mostly vertebrates	slow flight searching the ground; hover and dive; captures prey in trees
Spotted eagle owl	Opportunistic, diversity of small and large prey, up to 1kg	perch-search-swoop to ground
Cape eagle owl	Selective, single species forming main prey item	perch-search-swoop to ground
Giant eagle owl	Opportunistic, takes prey up to 17kg	perch-search-swoop to ground, also captures prey in flight, in trees or in shallow water
Buzzard	Opportunistic, prey up to 5kg taken, scavenging very common	perch-search-swoop to ground and also soar or hover and then dive, also captures prey in flight
Red kite	Opportunistic, prey up to 5kg taken, scavenging very common	slow flight searching the ground, also soar and then dive, also captures prey in flight
Hen harrier	Selective, mainly vertebrates, few insects	slow flight searching the ground, also captures prey in flight
The eagles	Opportunistic, takes prey up to 5kg, scavenging very common	soar and dive
Kestrel	Opportunistic, takes prey up to 200g	soar and dive, captures prey in flight or in bushes or trees

(After Andrews 1990a:Appendix Table 16 and Appendix Table 17)

** 'Opportunistic' means that , within certain size limits, the predator hunts what is available in its hunting range

2.5 Rodent communities

Variation in an archaeological micromammal assemblage in the mean size of the individuals of a species, in diversity, or changes in the composition of the micromammal community may be attributable to changes within the rodent community in which the predator hunts. This section attempts to put into perspective some of the changes which may occur in a rodent community. Changes in the rodent community affect predators, which in turn may affect the species composition of an archaeological assemblage. The factors influencing the diversity, population growth and distribution of small mammal communities are dealt with briefly below.

It became clear, after reading relevant literature, that there are still many unknown or incompletely understood variables influencing modern-day micromammal communities. Cyclic fluctuations of micromammal communities have been attributed to both extrinsic and intrinsic factors by different researchers but the exact factors governing fluctuations in the density and relative abundance of rodent populations are not known. It is impossible to ascertain not only all the variables acting upon and within a community, but their relative importance as well. Niche theory has attempted to cope with these and other questions regarding living communities with the development of concepts such as niche width and overlap, specialization and inter- and intra-specific competition. Increases in the mean body size of the individuals of a species, fluctuations in availability of food supply and in rainfall, competition (intra- or inter-specific), predation and the environment in which the animals live are all suggested as factors which may affect small mammal populations (Chitty 1960; Choate 1972; Redding 1978; Giller 1984; Perrin and Swanepoel 1987; Andrews 1990a). These concepts have provided explanations for the behaviour observed within many animal communities with competition appearing to be one of the main driving forces behind species diversity and density (Rosenweig and Winakur 1969; Giller 1984). If competition is the

primary factor controlling the distribution of a species, then that species cannot be used to monitor palaeoenvironments as its presence would indicate only the absence of its competitor and it would be wrong to interpret this in terms of environmental conditions (Choate 1972; Redding 1978; Giller 1984; Tamar 1991). Factors such as these could greatly complicate the analysis of archaeological material as they could lead to the misinterpretation of the causes of species diversity.

Though the situation is complex and the exact factors and the relative importance of the factors governing the population dynamics of a small mammal community are not thoroughly understood, certain species are generally found associated with a certain set of variables. For example, in a study done in the southern Kalahari, Brant's whistling rat, was found in association with the shrub *Rhigozum trichotomum,* while the Tree rat, was generally restricted to areas with large trees (Nel and Rautenbach 1975). Avery (1982) used the correlation of such factors with various species in her analysis of the composition, structure and mean size of the micromammal populations from several archaeological sites in the southern Cape Province. The problem with using the preferred habitats of micromammals for environmental reconstruction is that the descriptions are qualitative and not quantitative, that is, they do not look at the relative importance of different elements of the habitat (Avery 1982; Rowe-Rowe and Meester 1982).

Redding (1978) listed predation and sheltering conditions (for example, the presence of existing burrows) as possible factors influencing distribution. Different factors will influence different species which have adapted to live in specific ecological niches. For example, hard or clayey substrates may inhibit the presence of burrowing species. The Cape dune molerat and the Cape gerbil appear to be associated with sandy soil rather than any particular vegetation and it has been suggested that the preferred habitats of the Large-eared mouse and the Short-tailed gerbil are selected in order to enhance their particularly efficient hearing apparatus (Nel and Rautenbach 1975; Bigalke 1979; Mendelsohn 1982a). In a study of southern Kalahari ecology, amount of cover and the substrate appeared to be the most influential factors of distribution and diversity of the small mammals in the area (Nel and Rautenbach 1975). Changes in the variables affecting a rodent species may lead to changes in the density or distribution of a species, which could affect the number and variety of prey available to predators.

Different species will often react in very different ways to changes in climate and rainfall (and hence in vegetation). Each species has adapted to occupy a specific niche and may be dependant on different variables, such as particular food resources or cover. The same species in different circumstances may also react differently. In the southern Kalahari a particular species or group of species showed different survival values or differential responses when living in different habitats

(Nel and Rautenbach 1975). Once again, such behaviour may complicate the analysis of archaeological assemblages.

Species richness, abundance, diversity and dispersion of animal communities in the Northern Cape Province were found to be correspondingly higher at times when rainfall was higher than usual (Crow *et al.* 1981). There is a relationship between rodent breeding activity and rainfall. African rodents living in arid zones have shown a positive correlation between breeding and the occurrence of seasonal rain (Coetzee 1965; Mendelsohn 1982a). The oestrogen content in new grass has been cited as a possible catalyst for breeding (Swanepoel 1981; Perrin and Swanepoel 1987). Rain is not the sole influencing agent, however, and habitat has been shown to play an important role (Bronner *et al.* 1988). Sexual differences in the length and time of the breeding season has been observed in several species and this indicates that the different sexes respond differently to different conditions. Pinpointing the factors influencing the breeding seasons of different species of rodent still remains problematic as, in many instances, it is possible that more than one factor is at play. The breeding seasons of the different rodent species will have a direct affect on the food supply available to the predator and may result in a large number of young animals appearing in an archaeological assemblage.

Population increases may lead to behavioural changes, but there is still a debate over whether such changes are related to changes in genotype or phenotype (Krebs and Myers 1974). A species may show different behaviour when living in an allopatric as compared to a sympatric state (Giller 1984). For example, the Golden spiny mouse is usually nocturnal but becomes diurnal in areas where it is co-existing with the Common spiny mouse (Haim and Rozenfeld 1995). Perrin and Swanepoel (1987) note that some deserticolous rodents have made shifts in their reproductive capacity by moving along the r to k-strategy continuum as a result of variable environmental conditions. Behavioural changes such as those mentioned above could greatly complicate the interpretation of archaeological micromammal communities as the analyst would be unaware of them and could thus misinterpret them. There is, undoubtedly, great variability and range in the manner in which certain small mammals react to environmental and climatic change and we still do not fully understand it. This should be remembered when interpreting changes in archaeological assemblages in terms of environmental change.

2.5.1 The effects of fire on micromammal communities

Fraser (1990:52) notes that seasonally arid fynbos shrublands contain plant species which need fire to regenerate and notes that fire is the most important disturbance factor in Mediterranean ecosystems such as fynbos. The type of fire, its intensity, the season in which it occurs and the frequency with which an area is burned will all affect the ecological impact of the fire (Trollop

1993). Low diversity, abundance and dispersion was found to occur in years of drought or after a dry-season fire in a Northern Cape animal community (Crow *et al.* 1981). Avery (1982) writes that with natural disasters such as fire, all species should be equally affected and though the number of rodents might change, their composition should stay the same. This statement needs to be qualified as regards fires and ecological disturbances such as drought as the evidence suggests that the differing requirements of different species would cause them to react in very different ways.

Different species have different reactions to a fire. For example, the Multimammate mouse prefers disturbed, unpredictable habitats which are recovering from some form of disturbance (Meester *et al.* 1979; Bronner *et al.* 1988). When this species occupies such an area it breeds opportunistically, regardless of the suitability of the season and the chances for survival of the young (Bronner *et al.* 1988). This Multimammate mouse is able to occupy a wide habitat range and tends to be replaced by more specialised species once an area has recovered from a fire (De Graaff 1981). Different species re-occupy an area at different times after a fire, depending on their habitat requirements. For example, Hensbergen and Martin (1993) note that after a fire the Striped mouse, which is reliant upon ground cover, was found to be restricted to areas of unburnt vegetation. The Striped mouse re-occupies an area only after reasonable cover has grown (Rowe and Lowry 1982) and the Vlei rat, a specialist, k-selected species, which is dependant upon a slow growing microphyll cover, would recolonize even more slowly (Bond *et al.* 1980). Bond *et al.* (1980) suggest that a full recovery of an area after a fire could take three or four years, depending on the area.

Burrowing rodents may have an increased chance of surviving a fire. De Graaff and Nel (1992) note that the efficient burrows and tunnels of the Fat mouse help it to survive and cope with regular veld-burning. It has been suggested that the Vlei rat in the Transvaal Highveld may make burrows as an adaptive response to the veld fires which occur every dry season and which allow the Vlei-rats to survive this man-induced habitat destruction (Bronner 1992).

Swanepoel (1981) observed a small rodent community after a fire and noted no difference in the survival of nomadic, as opposed to resident, animals. There was, however, a significant difference in habitat selection after the fire and Swanepoel (1981) noted that it appears that social organization might play a role in determining the habitat selection by rodents after a fire. An increase in the nocturnal habits of all species after a fire was recorded and this was related to the effects of reduced available cover (Hensbergen and Martin 1993). An increase in nocturnal activity would make certain species more vulnerable to predation by nocturnal predators. Swanepoel (1981) suggests that the loss of vegetative cover makes the animals vulnerable to predation, lack of food and increased physical exposure. He suggests that the speed at which

recolonization of an area takes place after a fire is affected by the recovery of the vegetative cover. Crowe *et al.* (1981) studied the effects of fire on a northern Cape micromammal community and found that there was a clear, negative correlation between animal abundance and diversity and the percentage of bush cover and distance from water. It would thus appear that fire could have a great effect on rodent species diversity and may also effect relative species abundance.

It appears that a fire could have far-reaching effects on the rodent population in an area for a varying period, depending on the type of vegetation and the area and season in which the fire occurred. The evidence suggests that the composition of a rodent community and the density of individual species changes after a fire. If an archaeological sample of micromammals has been formed over a period following a fire, or even a drought, it is possible that the composition of this sample would be very different to that which may have been obtained prior to the disturbance. The length of time over which the archaeological sample was formed becomes relevant here as diversity would be decreased for a year or even a couple of years after a fire. If the archaeological sample was formed over a relatively short period, the diversity in a micromammal assemblage may be misinterpreted as representing a change in environment when in actual fact it is representing short-term fluctuations in the micromammal population, induced by a natural disaster.

To summarise, sections 2.4 and 2.5 attempted to deal with some of the factors that could influence which species from the available rodent community end up in an archaeological deposit. These sections listed changes in the identity of the predator, changes in predator behaviour, and changes within the rodent community in which the predator hunts, as potential causes of changes in species diversity, richness and so on, in archaeological assemblages. These factors provide an alternative explanation to that of palaeonenvironmental change.

Chapter Three Post-depositional physical damage

The following chapter is a summary of the taphonomic forces, besides those that are predator-induced (these are dealt with in the previous chapter), that may potentially have affected the microfaunal bones from Elands Bay Cave. Figure 3.1 below illustrates the potential modifications that may affect an animal from the time of death up until such time as the bones have been analysed.

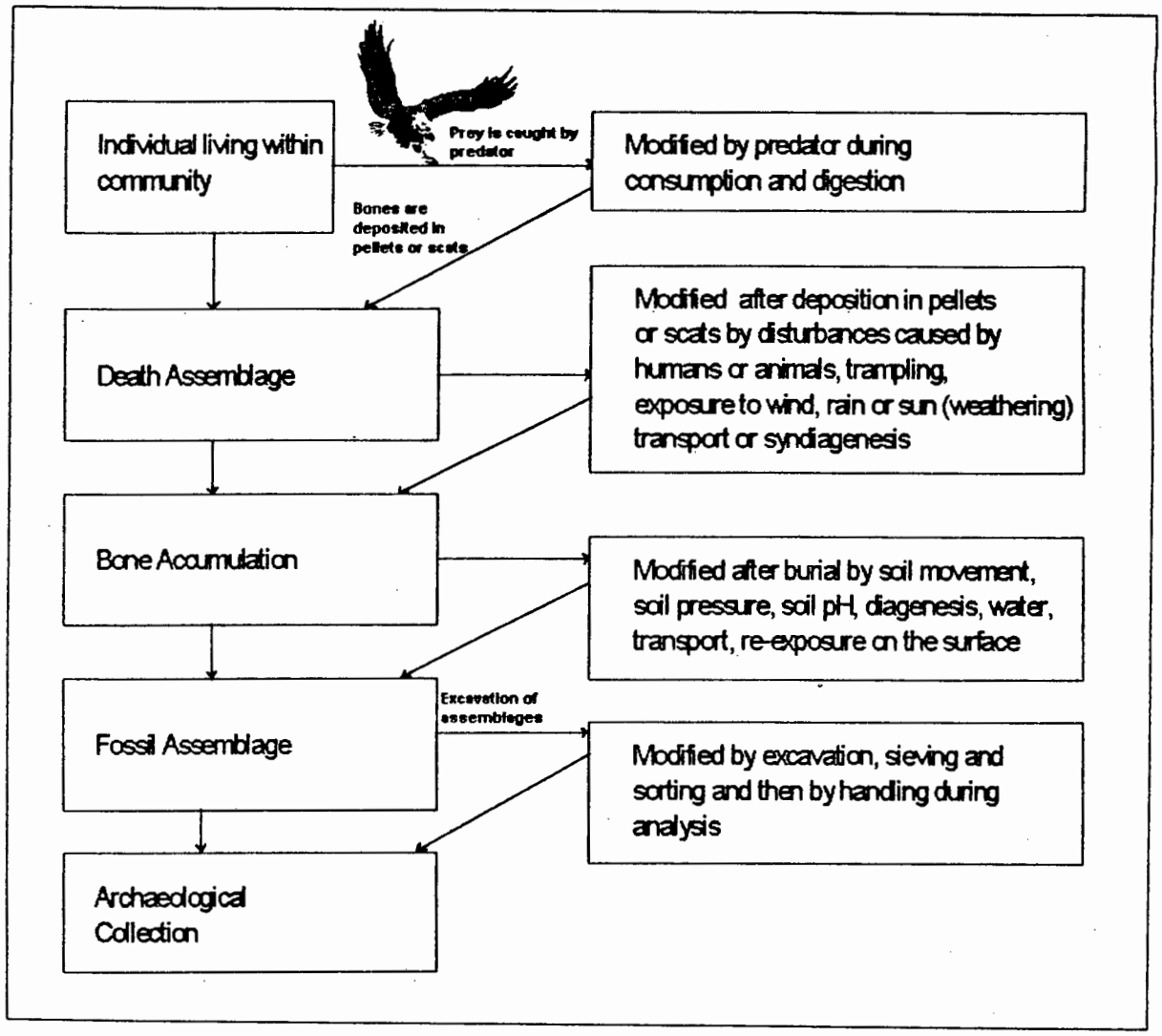

Figure 3.1: The formation and modification of microfaunal bone assemblages (After Andrews 1990a:Fig1.2, page 3)

3.1 Water

Water may transport small mammal bones and the water action may result in rounding or further breakage of the bones (Andrews 1990b). The bones of frogs and mice are likely to be subjected to wide dispersal by water (Dodson 1973). Vertebrae are among the first bones to be moved by water (Dodson 1973). Dodson (1973) noted, during experimentation with the movement of microfauna by

water, that the shape and the orientation of the bones influence their relative tendency to be transported by water. Size also affects how far bones are transported in water. This is illustrated by Dodson (1973) who investigated the difference in velocity between toad and frog bones and concluded that if the size of an element is increased by approximately 50%, corresponding to the linear size difference between the toad and the frog used in the experiment, the competent velocity would be elevated by a factor of approximately three. Dried bones would be buoyant and could float considerable distances before being deposited (Dodson 1973). At the Atapuerca-Ibeas Cave complex in Spain a shortage of mandibles and a large number of maxillae led Fernandez-Jalvo (1995) to conclude that the assemblage was formed by medium-low energy transportation - the lack of maxillae could be explained by either breakage or by transport sorting, but the former was ruled out because of the state of preservation of the maxillae and mandibles.

3.2 Etching caused by soil type

Andrews (1990b) notes that a variety of soil types may etch bones and teeth. Acid soils cause the most marked etching on teeth and bone, though etching may also occur in alkaline soils (Andrews 1990b). Chaplin (1971) notes that acidic soils will affect the mineral component of the bone at a rate dependant upon the degree of acidity of the soil and the amount of percolating water. Base rich soils lack the dissolving acid solution and are thus more conducive to the preservation of bone (Chaplin 1971). Solution is most rapid in cases where the soil is composed of non-calcareous sands and gravels or is derived from acid igneous rocks (Chaplin 1971). There are so many factors involved that it is not possible to make any sweeping generalisations as the influencing factors may change over time (Chaplin 1971). Porous bones with a large surface area and bones that have been previously exposed to heat will be particularly vulnerable to acid groundwater (Chaplin 1971). It is logical to assume that anything which damages the bones, that is, burning, weathering or acid etching from digestion, would weaken the bones and make them more prone to soil corrosion. Root marks may be etched into the surface of the bone and are generally easily recognizable under the microscope.

In the case of acid soils or predator digestion, preferential etching occurs first on tooth enamel and, only in more extreme cases, on dentine and bone (Andrews 1990a). Soil corrosion is discernible from the etching caused by predators in that it affects the entire area of the teeth and bones, whereas predator-induced etching occurs in restricted areas. Soil corrosion is distinguishable from weathering as it results in extensive pitting of the teeth and postcrania (Andrews 1990b). Very alkaline soil affects the bones and the dentine of teeth more than the enamel, and causes a superficial flaking or exfoliation of bone (Fernandez-Jalvo 1995). A similar appearance may result from weathering, however, in this case, the bones would become split and cracked before exfoliation takes

place. At the site of Gran Dolina, Atapuerca, in Spain, Fernandez-Jalvo and Andrews (1992) discovered that the majority of micromammal fossil bone on the site showed signs of post-depositional corrosion with the bone and tooth dentine appearing chemically dissolved, while the tooth enamel appeared unaffected. This pattern is the opposite to that discernible in cases where the bone has been etched by a predators digestive juices or by an acid soil environment - Fernandez-Jalvo and Andrews (1992) attributed this preferential etching of the bone and dentine to prolonged exposure to an active alkaline environment. Andrews (pers. comm.) states that this etching remains an unknown factor as it has only been observed in fossil sites (the limestone cave at Atapuerca) and not on any comparative material.

3.3 Damage caused by sediment type

Andrews (1990a) has shown that the nature of the sand/rocks in which the bones are deposited affects the degree to which they are damaged. He performed an experiment in which micromammal bones were mixed in a rotary mixer with various sizes of sediment. When mixed with finer sediments little additional breakage occurred but rounding of the bones was observed. The bones mixed with angular, pebbly gravel showed chipping and wearing away of the weaker bone. When two large clasts were added, the skulls and mandibles were reduced to fragments.

Experiments have shown that earthworms may move bones quite significant distances and may aid in the burial of bones lying on the ground surface (Armour-Chelu and Andrews 1991).

3.4 Trampling

Trampling can cause further damage to bones after their deposition on a site by a predator and the original predator-induced breakage patterns may be obliterated or distorted by the subsequent breakage. Post-depositional breakage should be distinguishable from predator-induced breakage as Andrews (1990a) has provided a clear picture of the various forms of damage caused by the different families of avian and mammalian predators.

Small bones may remain more or less in the context in which they were dropped as they are far less prone to size sorting or secondary disposal than bigger bones, especially in sandy or loose soil (Bartram *et. al.* 1991; Stevenson 1991). Ethnographic data has shown that trampling by people may result in the burial and preservation of bones (Behrensmeyer 1978; Gifford-Gonzalez *et al.* 1985). If pellets or scats were exposed to trampling, the softness of the substrate would affect the degree to which such pellets would be damaged. Once trampled upon, microfaunal bones would have been likely to become buried if the substrate were soft.

Andrews (1990a) studied the effects of trampling on owl pellets and concluded that:

- wet pellets were more susceptible to damage than dry pellets
- trampling by large mammals is destructive but the relative softness of the substrate is important, pellets lying on soft soil will tend to get pushed into the ground and will not be crushed
- pellets decay rapidly under damp conditions - rain dissolves the mucus coating the pellet and washes away hair, exposing the bones and making the pellets vulnerable to the entry of invertebrates and other insects which then break down the pellet (Philips and Dindal 1979).
- the pellets of different species show a varying resistance to breakdown (the Barn owl's pellets are comparatively compact and resistant to breakdown)

Andrews (1990a) performed a trampling experiment in which both wet, fresh and dry pellets were trampled upon in a plastic bag, and the resultant breakage patterns compared. After six trampling events the jaws were fragmented and the teeth appeared as isolated teeth, the major postcranial bones and the smaller bones (vertebrae, ribs and foot bones) all remained intact.

Trampling may result in the preferential removal of maxillae and mandibles from the archaeological record. A comparison between the numbers of cranial and postcranial bones on a site could be used to show that cranial material had been lost and, in such cases, to give a more accurate estimation of the number of individuals on the site.

Barn owls often make a nest by scraping together disintegrating pellets which are then subjected to trampling by the owl (Steyn 1984). The eagle owls also roost on the ground. Such nest areas contain a high proportion of trampled bone. Andrews (1990a) compared the bones from the disintegrated pellets of an Eagle and Barn owl (sample A) which had been trampled upon by the owls themselves, to the bones removed from complete pellets (sample B), the latter having been protected by the body of the pellet. The percentage of digested teeth was found to be the same in the nest site as compared to the bones from the pellets (Andrews 1990a). There were high numbers of mandibles in both samples but the relative proportions of the maxillae were far lower in sample A as opposed to sample B. In sample A there was a high percentage of isolated incisors which had been released as the maxillae became progressively more fragmented. Trampling led to breakage of the long bones and a resultant increase in proximal femora and distal humeri. There was some loss of the limb bones but no loss or breakage of small elements was found.

3.5 Weathering

The rate at which weathering takes place depends upon the conditions to which the bones are exposed. Temperature and moisture fluctuations and factors such as the wind, rain and sun all affect weathering (Behrensmeyer 1978; Andrews 1990a). Andrews (1990a) investigated the effects of weathering on micromammal bones by exposing owl pellets to weathering in mid-Wales where the climate is wet and windy. Pellets placed in a damp area disappeared without a trace in ten months. However, pellets exposed in dry conditions remained intact and after two years showed only some erosion of the pellet surfaces while the bones in the pellet showed no modification from weathering (Andrews 1990a). These pellets were then taken apart and the bones inside were exposed in an area where there was some slight protection to the wind but they were otherwise open to the elements and to weathering. The bones were then examined at various periods and the progressive stages of weathering recorded:

- **After 18 months of exposure:** The skulls and mandibles were found to be intact but sutures had started to open out in areas where they had been exposed to weathering. When examined under SEM the bones showed fine splitting along the orientation lines of the collagen fibre with penetration of very thin plates of bone, such as those seen on the scapula, with some breakage on the border. The molars showed fine chipping of the enamel edges and some splitting of the dentine which was attributed to differential contraction of the two layers (Andrews 1990a). The degree of splitting and chipping of teeth after 18 months of exposure was observed to be greater than that seen in any of the predator assemblages. Additional exposure of the bones up till 29 months, led to accentuation of the above features. Andrews (1990a) describes this weathering as being comparable to the stage one weathering of large mammal bones in a tropical climate as described by Behrensmeyer (1978).

- **After 29 months:** The changes in the cranial bones seen at 18 months were accentuated with further opening of the sutures. None of the postcranial bones showed any marked degree of modification as compared to the changes observed at 18 months. Further splitting and cracking of the bone had occurred, but not breakage.

- **After 36 months:** The only significant changes to be seen are in the surface alteration of the teeth and bones with splitting of incisor enamel and bone surfaces. Andrews (1990a) notes that the splitting of the bone is comparable to Behrensmeyer's (1978) stage 2 weathering for large mammals. Some small loss of basal and occipital bone and chipping of the ascending ramus was seen on the skulls. A 14% molar loss and 8% incisor loss was recorded. Andrews notes that these figures do not greatly differ from the figures obtained in the earlier stages.

- **After 48-55 months:** Little change had occurred in the bones, splitting and flaking was not much more advanced and despite the breakage of a few fragile protuberances on the skull bones, the bones showed little alteration.

Andrews (1990a) concludes that when comparing the weathering of small to large mammal bones, micromammal bones show the equivalence of Behrensmeyer's (1978) stage one weathering after 18-29 months (excluding the two months in the pellet) which is manifested by the cracking of bones, usually running parallel to the fibre structure. Stage two weathering was still proceeding after 48 months. Andrews (1990a) concludes that the results of weathering are readily discernible from other modifications such as those produced by soil corrosion, trampling or digestion.

On a site at Wookey Hole, in the U.K., bone showed extensive superficial pitting and vole molars showed degrading and pitting of the enamel surface (Andrews 1990a). The cause of the damage is uncertain but the bones appear to be affected when they are exposed, in dry conditions, on the surface. Further research into the effects of weathering on microfauna may aid in pin-pointing these as yet unknown variables (Andrews 1990a).

Chapter Four Methods

4.1 Introduction

The methods of analysis used for the micromammal assemblages from Elands Bay Cave were based upon the methods utilized by Andrews (1990a), whenever possible, so that the results obtained would be comparable to his results. In the case of the cranial bones, extra breakage categories were created to record the fairly advanced degree of breakage observed in the Elands Bay cranial material. Some of the analyses done by Andrews (1990a) proved to be unsuitable for the Elands Bay material, due to the manner in which the microfauna had been excavated. For example, the sieve sizes used would have led to the loss some of the smaller microfaunal bones, especially the smaller fragments and loose teeth. The sorters were also not specifically looking for microfauna and may have overlooked many of the less obvious bones or teeth during sorting. Calculations involving the relative abundance of skeletal elements, which were made by Andrews (1990a), were thus omitted as it was expected that the results from such calculations would be unsuitable due to the loss of bone and teeth through sieving and sorting.

The total number of mandibles, maxillae and long bones in the site, complete as well as incomplete, are listed in the beginning of chapter five in order to give some idea of the numbers in which these main cranial and postcranial bones appeared in the various packages. The breakage patterns of the ulna, humerus, femur, tibia and cranial bones from Elands Bay Cave were recorded in some detail, as was the acid etching on the incisors which was caused by predator digestion. Graphs were used to illustrate the trends observed in the breakage patterns of the femur and humerus and in the etching of the incisor enamel in the packages throughout the site. The breakage patterns of the long bones were analysed in conjunction with enamel etching on the incisors as breakage alone could not be used to ascertain the predator. Incisor etching was the key to the identification of the predator. When creating graphs to look for trends in the breakage patterns of the postcranial bones, only the packages containing five or more recordable incisors were used ('recordable incisors' were defined as those incisors which were sufficiently whole to ascertain whether or not they had been digested by a predator), as it was not considered productive to analyse those units of smaller sample size as the results would have been unreliable. Some of the packages used in the figures illustrating breakage of long bones and etching in the next chapter contained relatively small sized samples. It was recognised that, because of their small size, the results in these packages were inconclusive and somewhat unsatisfactory, but they were included in order to see where they fitted in terms of the general patterning. The small samples were also of interest in that they potentially

provided information about the areas in the site where the density of microfaunal bones was low.

Information was compiled on the various potential predators of microfauna at Elands Bay Cave. Information regarding preferred living and roosting areas, feeding habits, pellet formation and expulsion and latrine habits of the various species of owl, diurnal birds of prey and small carnivores was collected. This information, together with the taphonomic information obtained from the studies made of the microfaunal bones from Elands Bay Cave, was used to ascertain the predator or predators responsible for their accumulation. Avery's (draft paper) results for the palaeoenvironmental analysis of the micromammals from Elands Bay Cave were then discussed in terms of these results.

4.2 Recording the breakage of post-cranial bones at Elands Bay Cave

4.2.1 Breakage categories of long bones

All the cranial and postcranial bones from Elands Bay Cave are recorded in Appendix 5. The categories used to describe the breakage of the radius, ulna, humerus, tibia-fibula and femur of the micromammals at Elands Bay Cave were similar to those used by Andrews (1990a).

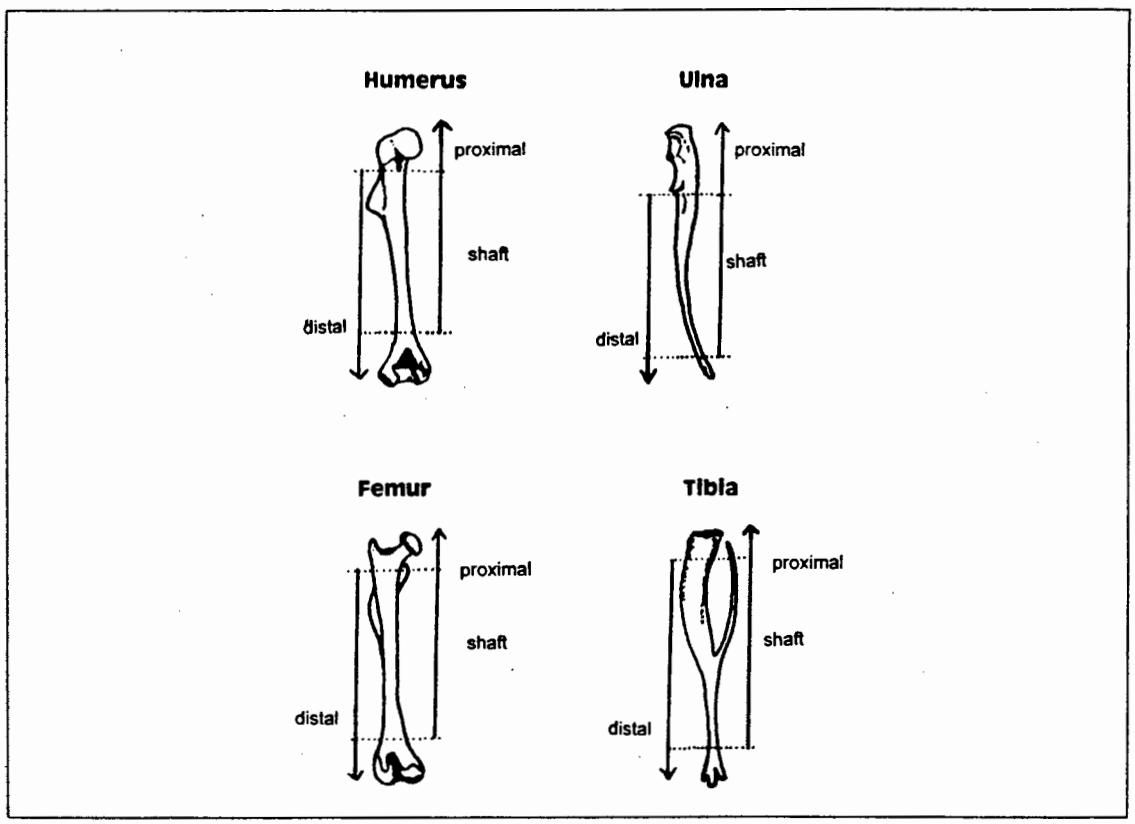

Figure 4.1: Breakage categories used in the classification of long bones

A bone was termed 'complete' if it retained part of the proximal and distal articular ends, as well as the shaft. If the proximal and distal articular ends were lacking, and a part or all of the shaft was present, it was categorised as a 'shaft'. A long bone was recorded as 'proximal' or 'distal' if it retained only the proximal or distal articular end of a long bone, or a proximal or distal articular end and a portion or all of the shaft. These breakage categories are illustrated in figure 4.1.

Body parts have generally been recorded separately, although sometimes two or three of the same body parts, may have been recorded together. In this case, instead of a '1' the number of bones being recorded would appear under the relevant body part. A tentatively identified bodypart was recorded as a '?1' and was not used for purposes of analysis. These rules were applied to all the postcranial bones.

The acronym for the name of the relevant unit appears in the first column of the spreadsheets in Appendix 5 and the body part found in that unit appears under the relevant column. For example, a distal femur found in square X3 of the unit Idi Amin would be recorded as illustrated in figure 4.2 below:

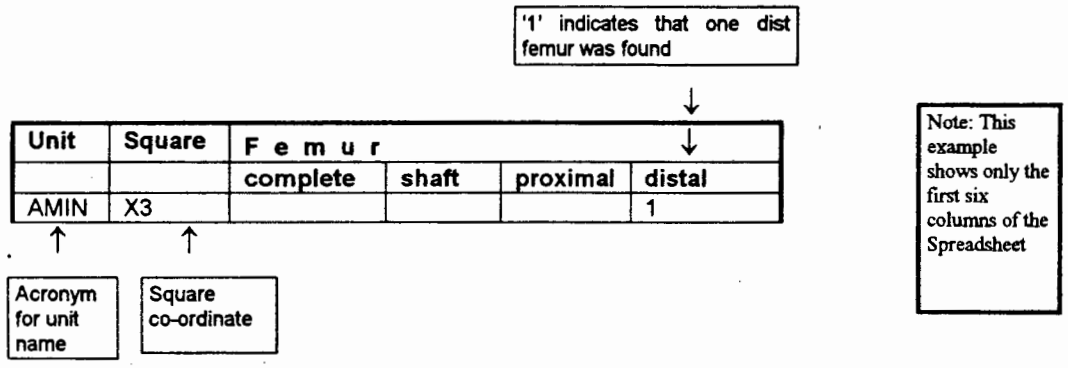

Figure 4.2: Recording the long bones

As in the analyses done by Andrews (1990a), only the breakage patterns of the humerus, ulna, femur and tibia were investigated as the more fragile radius was very scarce and it seemed logical to use the more robust ulnae bones from Elands Bay Cave to represent the upper fore-limb.

The thin, delicate fibula, which is fused to the tibia, was often broken off or incomplete in the Elands Bay Cave assemblage. Andrews (1990a) did not note the presence or absence of these bones and it did not seem profitable to do so for the Elands Bay fibulae.

The different species of micromammals are not differentiated on the spreadsheet, the exceptions being the insectivores - the shrews and the golden moles. Bones belonging to these

species are noted as such in the 'comments' column, which is the last column appearing on the spreadsheet. This distinction was made as the cranial breakage categories for the insectivores were slightly different to those for the other micromammal species due to the differences in their dentition.

An attempt was made to try and ascertain whether the trends observed in incisor etching and in humerus and femur breakage in the different packages were retained when the units within those packages containing relatively dense concentrations of micromammals were added together and analysed. The units containing sparse accumulations of micromammals were thus excluded from the analysis. The logic behind this was that an analysis of the units containing dense concentrations of micromammals should pick up any anomalies within the packages and should also show if adding units together to form packages has obscured variation in what is happening within a package. In some cases, the majority of units contained relatively high concentrations of bone and thus the final results were very similar to that obtained from the total package. In other cases, a great number of units were excluded from the analysis as they contained sparse accumulations of micromammals. The rather arbitrarily demarcated 'dense accumulations' were taken to be those units containing 5 or more buckets of deposit and a concentration of $5g/m^3$ or more, of micromammal bones.

4.2.2 Recording the other postcranial bones

The postcranial bones, other than the long bones, were initially recorded as Andrews (1990a) had recorded and used them for the purposes of analysis in his case study of microfaunal assemblages from the archaeological site of Westbury. However, once total numbers of bodyparts had been compiled for the different packages it became clear that these bones would not be useful for the purposes of analysis as their relative paucity indicated that post-depositional damage and, very probably, the sieve sizes used in excavation, had taken their toll on these bones. This loss of the more fragile bones from archaeological assemblages has been noted by Hoffman (1988) who wrote that the ribs, carpals, tarsals, metapodials, phalanges and vertebrae of micromammals are rarely recovered from the fossil record. These bones did indeed appear in low numbers in Elands Bay Cave.

The innominate was identified as complete if it contained all or most of the acetabulum, ilium, ischium and pubis and was recorded under the heading 'complete innominate' on the spreadsheet. Slight damage was therefore discounted. A portion of either the acetabulum, ilium, ischium, or the acetabulum and a part of one or two of the pelvic bones was recorded under the heading 'portion of innominate'.

Vertebrae were recorded under the category 'vertebra' if they were complete or in the category '$^1/_2$ - $^3/_4$ vertebra' if they had suffered damage. Very few complete scapulae were found and if only slightly damaged they were put into the 'complete scapula' category on the spreadsheet. Fragments were recorded as 'scapula fragments'. Clavicles, or portions thereof, were recorded under the 'clavicles' column as breakage to these bones was not recorded.

The calcaneum and astragalus, carpals, tarsals, metacarpals, metatarsals and phalanges were all put in the same category, 'foot and hand bones', and not further distinguished as these bones were not used for the purposes of analysis.

It did not appear that the fragile ribs had survived deposition and recovery as no ribs were found among the microfaunal bones.

4.3 Recording breakage of cranial bones at Elands Bay Cave

The Elands Bay cranial material was recorded in much the same way as the postcranial bones and appears together with these bones in Appendix 5. Cranial fragments which could not be identified were noted down in the 'cranial fragment' column, as were the cranial bones other than the mandibles and maxillae, such as the auditory bullae. These 'cranial fragments' were not used for purposes of analysis. Any cranial bone which was tentatively identified was recorded under the relevant cranial column with a '?' in front of it to indicate uncertain identification and was not used for the purposes of analysis. Schematic drawings of the mandible and maxilla may be seen below in figure 4.3.

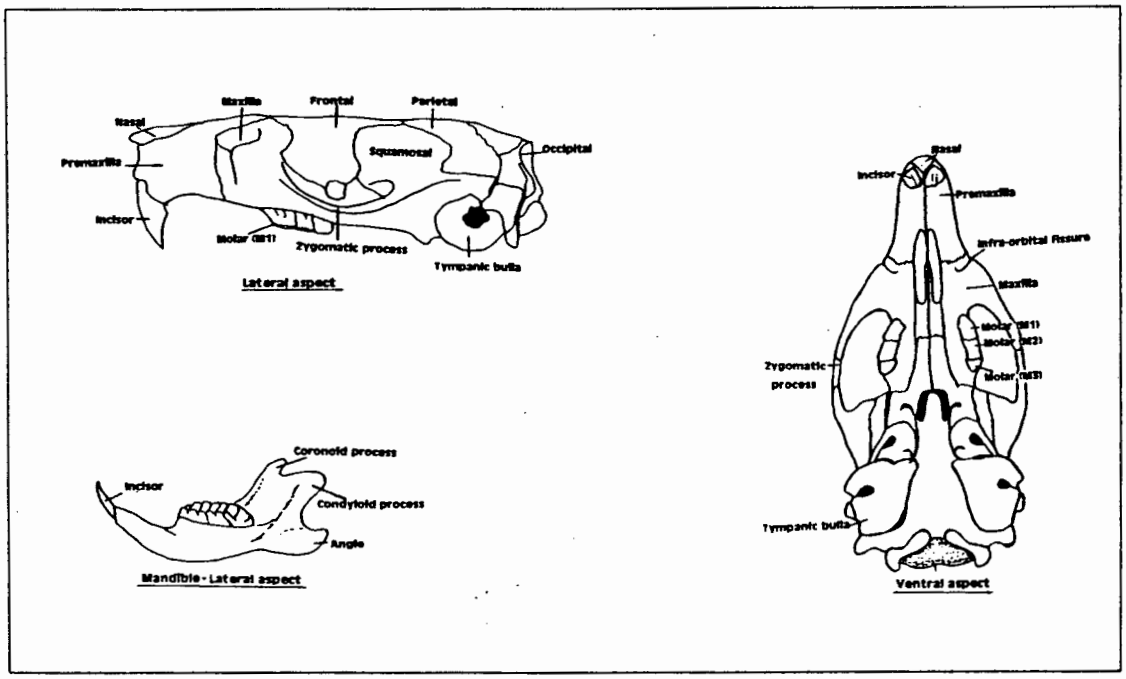

Figure 4.3: Schematic drawing of the mandible and skull (After Rowett 1964: Appendix, Page 49-51)

The premaxillae were usually separated from their maxillae and in this case were simply recorded in the 'premaxilla' column. If a) the left and right maxillae and premaxillae were still joined together, or b) if the left and right premaxilla, or c) left and right maxilla remained attached, they were recorded in the appropriate columns (that is, under the column entitled 'maxilla' and 'mandible') and were then noted in the 'comments' column as; a)'left and right maxilla and premaxilla joined', b)'left and right premaxilla joined', or c)'left and right maxilla joined', respectively. This would be recorded in the comments column of both the left and right body part, so that, for example, a left and right maxillae still attached to their premaxillae and each other would be recorded twice, once for the left and once for the right maxilla (see Fig.4.4). The premaxillae would likewise be recorded twice. Figure 4.4 shows only the relevant columns of the spreadsheet.

Unit	Square	Premaxilla	Premaxilla fragment	Maxilla	Comments
AMIN	X3			1	Left and right maxilla and premaxilla joined
AMIN	X3			1	Left and right maxilla and premaxilla joined
AMIN	X3	1			Left and right maxilla and premaxilla joined
AMIN	X3	1			Left and right maxilla and premaxilla joined

Figure 4.4: Recording the cranial bones

The only other cranial breakage categories recorded were those cataloguing mandible and premaxilla fragments. If the premaxilla was extremely fragmented it was identified as a 'premaxilla fragment'. Mandible fragments were recorded under the 'mandible fragment' column. A maxilla 'fragment' would be classified as a maxilla with category D3 breakage - these breakage categories are explained below.

Loose incisors were recorded under the 'single incisors' column if they showed little damage. If broken they were recorded as a 'incisor fragment'. Loose molars were recorded under the 'single molars' column. A tooth which was still attached to a fragment of jawbone was recorded in the 'single molars' column.

4.3.1 Breakage of the maxilla and mandible

The detachment of the maxilla from the rest of the skull is an indication of one of the first stages of breakage observed in the skull (Andrews 1990a). Andrews (1990a) quantified this by comparing isolated maxillae with the number of maxillae present in skulls and the number of maxillae retaining a zygomatic process. This kind of comparison was not possible with the bones from Elands Bay Cave due to the degree of breakage of the skulls. The maxillae from Elands Bay Cave had become separated from their skulls, with very few maxillae still remaining attached to the premaxillae or retaining a zygomatic process - this degree of

breakage was only recorded by Andrews (1990a) most extreme breakage category, category D, which contained single maxillae (that is, the left and right maxillae had become separated) which lacked a premaxillae.

It became clear when studying the mandibles from Elands Bay Cave that they were relatively badly damaged. There were very few complete mandibles and the majority had damage to the ascending ramus, some or all of the alveoli (ie. the body of the mandible was broken) and the inferior border. Breakage categories were thus created to record the greater fragmentation of the mandibles and maxillae from Elands Bay Cave. These categories are described below:

The mandible breakage categories for Elands Bay Cave:

Category D0 Complete mandibles, slight damage to the ascending ramus was disregarded

Category D1 Ascending ramus missing. The alveoli of all the molars (with or without teeth) present

Category D2 Ascending ramus missing and the alveoli (with or without teeth) of M1 and part, or all, of M2 present, diastema intact

Category D3 A portion, or all, of the alveoli of M1, the inferior border was frequently broken and the incisor missing in this category , the diastema was generally, though not always present

The maxilla breakage categories for Elands Bay Cave:

Category D0 Maxilla still joined by the palatine bone to its opposite maxilla. These maxillae were, for the purposes of comparison with Andrews' results, termed 'complete' even if they lacked the zygomatic process and were therefore not strictly 'complete'.

Category D1 Alveoli (with or without teeth) of M1, M2 and M3 present

Category D2 M1 and M2 (with or without teeth) present, a portion of the alveoli of M3 may have also been present

Category D3 Fragment of maxilla, with a portion, or all, of the alveoli of M1

Many of the maxillae from Elands Bay Cave had suffered damage to the alveoli of the three molars, with only part of these alveoli remaining. This damage was recorded under the categories D2 and D3.

A mandible from the unit 'Amin' showing category D1 type damage, and a maxilla with category D2 type damage would be recorded as illustrated in figure 4.5:

UNIT	SQUARE	CRANIAL	MANDIBLE	MANDIBLE	PREMAXILLA	PREMAXILLA	MAXILLA	DAMAGE
		FRAGMENT		FRAGMENT		FRAGMENT		CATEGORY
AMIN	X3		1					1
AMIN	X3						1	2

Figure 4.5: Recording the damage categories of the mandibles and maxillae

4.4 Tooth loss

Tooth loss (molar and incisor loss) from the mandibles and maxillae was used by Andrews (1990a) to document the progressive breaking up of skulls. Damage to the premaxilla or to the inferior border of the mandible results in the loss of the incisor while damage to the alveolar borders causes molar loss.

Calculations involving tooth loss are, however, very likely to have been affected firstly, by the relatively rough treatment they received during sieving and sorting, and secondly, by the extensive handling that the micromammal bones from Elands Bay Cave have experienced during analysis. The cranial bones (the mandibles and maxillae) were analysed by D.M. Avery, of the S. A. Museum and they were weighed by a research assistant. This involved a certain amount of handling. The bones were then re-sorted and re-weighed for the purposes of this research project as the earlier weights were found to be incorrect as many non-microfaunal bones had been included during the first weighing of the bones. The bones, both cranial and postcranial, were then taken out of their bags again and recorded for the purposes of this project. An investigation of the breakage of molars and incisors from Elands Bay Cave was then done some time after the initial identification of the bones. Further examination of the acid etching on the incisors was done even later. As a result of this, the total number of incisors (isolated and *in situ*) obtained from the acid etching examination differed slightly in some units to the numbers obtained in the tooth breakage examination. This can be attributed to the further breakage of jawbones or teeth during storage and handling and human error. The fact that handling caused a quantifiable difference, has implications which may help provide some explanation as to why the indices measuring molar and incisor loss show rather inconclusive results for the Elands Bay Cave micromammal material. Ascertaining the potential changes that can occur in the process of analysis of microfaunal bones will enlighten us, both as to how the archaeologist may influence an assemblage, and also in formulating the best methods with which to approach microfaunal analysis.

4.4.1 Calculation of tooth loss

Tooth loss was not calculated for the insectivores due to the low frequencies of mandibles and maxillae found throughout the site for these species. The assumption was made for all the calculations involving tooth loss that the mandibles and maxillae from the Muridae had originally contained three molars and one incisor. Percentage tooth loss was calculated by dividing the number of missing teeth, that is the number of empty tooth sockets, by the number of teeth expected, given the number of mandibles or maxillae in an assemblage, and multiplying this result by 100.

The percentage molar loss and the percentage incisor loss of the mandibles was calculated for all the packages. Percentage molar loss was calculated for the maxillae but not percentage incisor loss as separation of the premaxillae from the majority of maxillae in the site had facilitated the loss of the incisor and the results would not, therefore, have been comparable to those of Andrews (1990a). For the purposes of analysis, the packages containing relatively few mandibles or maxillae were ignored when looking for general trends in the results as the small sample size of some packages made the results obtained from these packages unreliable. Only the results for packages containing 15 or more mandibles or 10 or more maxillae (there were fewer maxillae than mandibles on the site) were therefore used when comparing packages in order to look for any trends. These numbers are arbitrarily chosen in order to make comparisons between the different packages and not because these sample sizes were considered to be satisfactory.

4.4.2 Calculation of the percentage of isolated molars

A comparison between the number of empty tooth sockets in the mandibles and maxillae and the number of loose teeth in the different packages was made in order to see what percentage of the empty sockets were accounted for by the number of loose molars and incisors. A deficit of isolated teeth could indicate preferential loss of teeth from an assemblage (Andrews 1990a). Surplus teeth, on the other hand, would indicate that the bodies of the mandibles and maxillae had been totally destroyed, with the teeth alone remaining (Andrews 1990a). If there has been no selection for teeth or jawbones, the numbers should be approximately equal and the percentage should fall around 100%. Once again, due to the high frequency of incisor loss at Elands Bay Cave, the percentage of isolated incisors was not calculated. In order to do this calculation the number of loose molars was counted in each package and then divided by the number of empty alveolar spaces in the mandibles and maxillae and multiplied by 100. It was expected that, given the sieve sizes used for excavation, there would be low percentages of isolated molars in the site. The calculation of the percentage of isolated molars was thus made

mainly in order to ascertain to what degree there had been preferential selection against loose teeth in the site.

4.5 Breakage of molars and incisors

The teeth from Elands Bay Cave were divided into the breakage categories as defined by Andrews (1990a). *In situ* molars were recorded as broken when a portion of the crown was missing or damaged. Isolated molars, however, were initially divided into the categories 'chipped' and 'split' although, for purposes of analysis, these categories were added together. A tooth was defined as split when a break ran vertically through the crown and separated a whole section of a cusp and root or lobe of a tooth. Andrews notes that the longitudinal splitting of the crown of isolated molars is sometimes associated with digestion and this type of breakage can be applied equally to both cricetid and murid teeth.

Cracks on the upper and lower incisors were not counted as breaks, actual division of the tooth had to take place (Andrews 1990a). It would appear that in his category of 'broken incisors' Andrews (1990a) included incisors broken both proximally and distally. However, in this study, an incisor was only counted as broken if the proximal tip was broken off as virtually all incisors showed damage to the distal end of both the upper and lower incisors. Very slight damage/chipping to the proximal tip was not recorded as most of the teeth showed a small amount of damage in this area. Double-counting of incisors which had split in half did not appear to be a great problem with the Elands Bay Cave incisors as it appears that small segments of incisors were either not recovered during excavation or, alternatively, did not survive in the archaeological record. Generally, substantial parts of the incisors were recovered and small segments, which may have belonged to an incisor in the unit which had already been recorded, were very rare. Longitudinal breakage was much more likely to result in double-counting, but once again, this breakage was not common.

4.6 Post-cranial to cranial proportions

The proportion of post-cranial to cranial elements was calculated to see if there had been preferential selection or damage of either group. The idea behind these calculations is that if there has been no damage to the bones, the number of humeri, femora, tibiae and ulnae should correspond with that of the mandibles and maxillae and departure from this could show some kind of preferential damage, or selection against, the body part concerned. The total numbers of humeri and femora were divided by the number of mandibles plus maxillae;

(1) (femur + humerus)/(mandibles + maxilla) x 100.

Selection for or against proximal, as opposed to distal, elements was checked by dividing the number of tibia and radii by the number of femora and humeri and calculating the percentage;

(2) (tibia + ulna)/(femur + humerus) x 100

4.7 Recording and analysing the acid etching on the incisors from Elands Bay Cave

In his study of predator scats Andrews (1990a) looked at the acid etching on both the incisors and molars found in the predator assemblages. For the purposes of this study, however, only the incisor etching was studied as the large number of molars involved and the lack of comparative material made a study of the molars impractical. Andrews (pers. comm.) notes that the etching on incisors is a better indicator than that on the molars in that there are fewer structural differences between the incisors, as compared to the molars, of the different rodent taxonomic groups. Due to this similarity, digestion affects the incisors in a similar way and taxonomic differences need not be taken into account (Andrews 1990a). Incisors are also suitable in that they showed generally lower levels of breakage and higher levels of etching than the molars in Andrews (1990a) predator assemblages.

Digestion in the predator assemblages was found to be higher on *in situ* upper incisors than on lower ones and higher on isolated teeth than on *in situ* ones in the predator assemblages (Andrews 1990a). Once incisors become detached from the mandibles and maxillae, however, they show an equal propensity to become etched.

The incisors from Elands Bay Cave were recorded separately as isolated lower incisor, isolated upper incisor and incisor *in situ* in the mandible or premaxilla. The presence or absence of etching as well as the degree of the etching was then recorded. The total percentage of etched, as opposed to unetched, incisors was then calculated for each unit and for the total package. The area in which the etching occurred on the incisor was noted, namely, whether it was on the side and tip, tip only, along the sides or all over the incisor. The etching on a tooth was classified as unidentifiable when breakage or loss of parts of the tooth prevented an accurate identification of the etching on an area of the tooth.

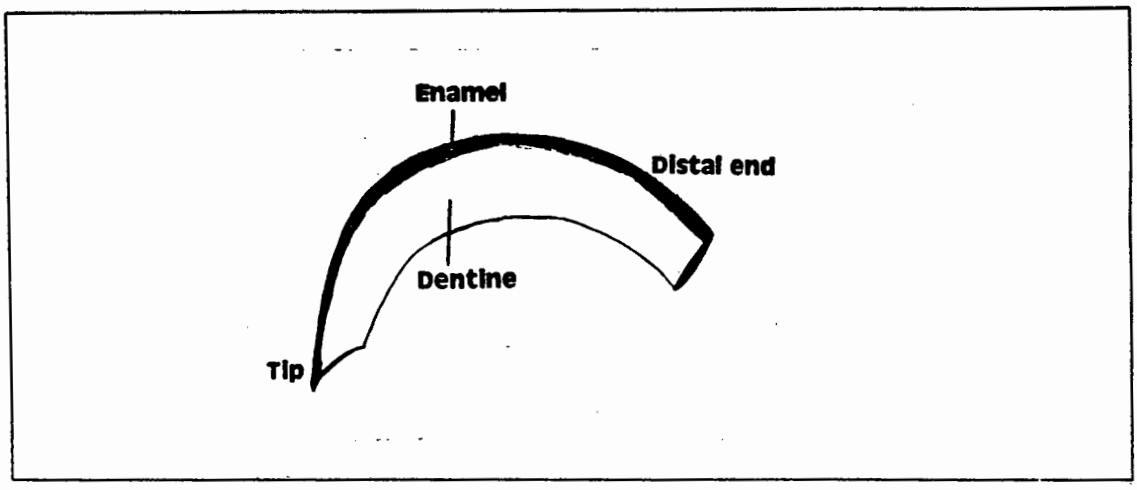

Figure 4.6: The incisor

A diagram illustrating the morphology of the incisor may be seen in Figure 4.6 above. The acid etching on the incisors from the site was recorded with the aid of a light microscope. A wide range of magnifications were used.

Sometimes both the enamel and dentine of an incisor were etched, while at other times only the dentine showed etching. The etching on dentine and enamel was thus recorded separately in order to try and ascertain whether separate taphonomic processes had been involved. The etching of the dentine usually occurred at the tip of the teeth.

The etching on the incisor enamel was categorised and recorded in one of the categories described below. The presence of dentine etching was merely recorded and was not quantified as it was very uniform in appearance on the incisors throughout the site. For the purposes of analysis, the total percentage of incisors showing etching on the dentine and on the enamel in a package was calculated. The percentage of incisors falling into each etching category was also calculated.

The enamel etching categories of the incisors at Elands Bay Cave:

Category 0	No visible etching on the incisor
Category 1	Slight pitting and digestion of the enamel in a small area (usually the tip), etching has not penetrated to the dentine
Category 2	Area of digestion not much greater than category 1, but etching was through to dentine
Category 3	Much more extensive area of digestion with total removal of enamel in areas, underlying dentine exposed and digested
Category 4	Almost total removal of enamel with extensive digestion of dentine.

4.7.1 Mechanical damage to incisors

Features such as hairline or open cracks, root marks, puncture marks, scrape marks, exfoliation, chipping, pitting and manganese staining or the presence of crystals on the incisors were recorded. Damage to the enamel at the tip of the incisor, such as chipping or breakage, was recorded, as was chipping or cracking of the dentine at the tip.

A peculiar type of flaking was observed on the majority of the distal ends of the incisors in the site and this was recorded when observed. This flaking was very uniform in appearance and always occurred on the distal end of the incisor where the enamel looked denatured. The enamel was also often chipped or absent in the distal area, exposing the underlying dentine. Two or three parallel grooves, almost like deep scrape marks, often appeared on the enamel. The presence or absence of this type of damage was recorded. Even teeth which were *in situ* (but were loose) when gently removed, were observed to show this distal flaking. The enamel of the incisor thins towards the root of the tooth and at the distal end is still hardening and forming and this part of the tooth is thus vulnerable to damage. Andrews (pers. comm.) notes that this distal damage is a natural phenomenon which he has observed on comparative material and is a result of the difference in developing enamel.

4.8 Analysis of the shrew bones

Andrews (1990a) recorded the cranial and postcranial breakage of the shrew bones with that of the other micromammals and this was done for the Elands Bay Cave material, with the exception of the cranial bones of the elephant shrews whose mandible morphology was very different. The elephant shrews appeared in very low frequencies in Elands Bay Cave and were excluded from the analysis due to their scarcity and also the lack of comparative analyses done on this species by Andrews. The breakage of soricid mandibles and maxillae was recorded in the same way as for the other micromammals, except that breakage category D2 was adapted to include the greater number of teeth of the shrew. Thus a shrew mandible classified as D2 would have approximately half of the tooth sockets (with or without teeth) present, the diastema intact but the processes missing. Category D3 would include mandible fragments with only 1-2 alveolar spaces or teeth intact. The incisors of the different shrew species at Elands Bay Cave were not examined for acid etching as many of the mandibles and maxillae had lost their incisors and sample size would have been too small to make analysis worthwhile.

4.9 The lizard and frog bones

The lizard and frog bones bones, which were scattered throughout the site in extremely low frequencies, were recorded in the same way as the micromammal bones but appeared in numbers too small for analysis. No cranial material was found for the frogs and only a limited number of lizard and frog postcranial body parts were found. The frog and lizard bones are recorded separately from the micromammals and are listed in Appendix 6. The format of the spreadsheet on which these bones were recorded was amended to take into account this paucity of bone.

Chapter Five: Results

5.1 The cranial and postcranial bones at Elands Bay Cave

The total number of postcranial and cranial bones in the different packages of the site are listed below in Table 5.1 and Table 5.2 in order to give some idea of the body-part representation at Elands Bay Cave.

Table 5.1: Number of mandibles, maxillae and long bones at Elands Bay Cave

Package	cranial		postcranial				
	mandibles	maxillae	femora	tibiae	humeri	ulnae	radii
1	3	0	1	1	0	0	0
2a	9	6	5	5	7	1	0
2b	5	6	6	4	5	0	0
3a	61	55	77	44	54	17	5
3b	16	13	8	5	17	3	0
3c	13	5	6	1	2	2	0
3d	3	2	3	0	3	0	1
4a	1	2	0	1	0	0	0
4b	7	4	0	1	2	2	0
4c	0	0	0	1	0	0	0
5a	4	4	4	1	9	4	0
5b	7	9	0	0	0	0	1
5c	17	15	11	2	8	4	0
6	45	32	26	21	23	4	1
7a	10	7	4	2	3	0	0
7b	4	8	3	4	0	1	1
8a	36	23	50	29	38	9	2
8b	36	36	34	30	30	5	0
9	140	112	101	54	101	25	0
10a	8	3	3	5	2	0	0
10b	1	1	3	4	2	1	0
10c	28	7	14	6	7	3	1
10d	7	7	10	10	5	0	0
11a	108	38	20	26	12	4	2
11b	0	2	2	0	0	0	0
12	5	0	3	0	0	1	0
13	144	55	61	62	37	13	2
14	58	26	8	12	4	6	3
15a	0	0	2	0	1	0	0
15b	35	11	42	14	28	4	0
15c	24	17	5	9	2	0	0
16a	9	5	15	4	4	1	0
16b	1	0	1	0	0	0	0
16c	5	3	20	5	4	0	0
17a	3	3	6	6	2	0	0
17b	0	0	1	0	0	0	0
18a	0	0	1	1	2	0	0
18b	3	0	0	3	1	1	0
19a	6	4	10	3	6	2	1
19b	0	0	0	0	1	0	0
20a	0	0	1	1	0	0	0
21c	0	0	0	0	0	0	0
22a	0	1	1	0	0	0	0
22b	0	0	0	0	0	0	0

The number of vertebrae found on the site (both complete and damaged), the total number of pelvic bones (complete and fragments thereof), as well as the totals of foot and hand bones (that is, phalanges and metapodials) and the calcaneum and astragalus are listed below in table 5.2.

Table 5.2: Number of other postcranial bones

Package	No. total vertebrae	No. innominate bones	No. scapulae or partial scapulae	No. metapodials & phalanges	No. calcanea & astragali
1	0	0	0	0	0
2 a	21	2	0	0	0
2 b	6	1	0	1	0
3 a	154	39	10	10	1
3 b	4	10	1	0	4
3 c	0	0	0	0	1
3 d	0	1	0	0	0
4 a	0	0	0	0	0
4 b	2	1	0	0	0
4 c	0	0	1	0	1
5 a	3	1	1	0	0
5 b	4	0	0	0	0
5 c	27	4	1	0	0
6	16	9	2	0	2
7 a	10	0	0	1	0
7 b	6	0	0	0	1
8 a	94	24	4	3	3
8 b	57	23	2	5	2
9	139	52	11	4	5
10 a	3	2	0	0	0
10 b	2	2	0	0	0
10 c	2	1	2	0	0
10 d	5	4	0	0	0
11 a	10	20	2	0	0
11 b	0	0	0	0	0
12	0	2	0	1	1
13	18	23	7	3	1
14	12	19	0	1	2
15 a	0	0	0	0	0
15 b	23	27	0	2	2
15 c	6	3	1	0	0
16 a	1	4	0	0	1
16 b	0	0	0	0	0
16 c	7	3	0	2	3
17 a	5	1	1	2	3
17 b	0	0	0	0	0
18 a	4	1	0	2	1
18 b	3	0	1	0	0
19 a	5	2	0	1	5
19 b	0	0	0	0	0
20 a	0	0	0	0	0
21 c	1	0	0	0	0
22 a	0	0	0	0	0
22 b	0	1	0	0	0

The vertebrae were found in greater numbers in packages of the site that produced relatively high frequencies of cranial and postcranial material. The low frequency of scapulae, metapodials, calcanea and astragali indicates that there has been some kind of selective bias against these bones. Compared to the number of maxillae and especially mandibles on the site, the number of postcranial bones is generally low. The following numbers will aid in putting in perspective just how many of these postcranial bones are missing from the microfaunal assemblages from Elands Bay Cave - One mouse is composed of 54 vertebra while the forefoot contains 14 phalanges, 5 metacarpals, 4 distal carpals (numbers 4 and 5 are fused), the fused radiale and intermedium, the ulnare and the centrale (Dodson and Wexlar 1979). The hind foot is composed of 14 phalanges, 5 metatarsals, 4 distal tarsals (no. 4 and 5 are fused), the tibiale, the centrale, the calcaneum and the astragalus (Dodson and Wexlar 1979).

5.2: Cranial Breakage at Elands Bay Cave

The cranial breakage of the Elands Bay Cave material was recorded under the categories explained in the previous chapter. In Table 5.3 the percentage of complete and damaged (all

three damage categories, D1, D2 and D3 were added together) maxillae and mandibles are compared.

Table 5.3: Percentage of complete vs damaged mandibles and maxillae

Package	MANDIBLES			MAXILLAE		
	No of mandibles	% D0	% D1+D2+D3	No. of maxillae	% D0	% D1+D2+D3
1	3	33.3	66.6	0		
2a	9		99.9	6		99.9
2b	5		100	6		100
3a	61	6.5	93.43	61	11.47	88.45
3b	16	6.25	93.75	13		99.99
3c	12		99.9	5		100
3d	3	33.3	66.6	2		100
4a	1		100	2		100
4b	7		99.98	4		100
4c	0			0		
5a	4		100	4	50	50
5b	7		100	9		99.9
5c	17	11.76	88.22	15		99.8
6	43	9.3	90.69	36		99.9
7a	10	10	90	7		99.99
7b	4		100	8		100
8a	36	16.6	83.26	23		99.91
8b	36		99.99	36		99.9
9	140	2.14	97.84	113	1.76	98.19
10a	8		100	3		99.9
10b	1		100	2		100
10c	28	10.71	89.28	6		99.9
10d	7		99.99	7		99.98
11a	108	11.3	88.85	39	2.56	97.42
11b	0			2		100
12	5		100	0		
13	147	5.4	94.52	55	3.6	96.33
14	58	17.24	82.74	26	7.69	92.18
15a	0			0		
15b	35	2.85	97.13	11		99.99
15c	24	16.6	83.32	17	23.52	76.46
16a	9		99.9	5		100
16b	1		100	0		
16c	5		100	3		100
17a	3		99.9	3		100
17b	0			0		
18a	1		100	0		
18b	2		100	0		
19a	6		100	4		100
19b	0			0		
20a	0			0		
21c	0			0		
22a	0			1	100	0
22b	0			0		

As may be seen from the above results, there were very few complete maxillae and mandibles found in Elands Bay Cave. It became clear early on in the analysis of the cranial material that post-depositional forces and subsequent breakage had obscured many of the original, predator-induced patterns.

5.2.1 Maxillary and mandibular tooth loss

Percentage molar loss and percentage incisor loss were calculated for the mandibles from Elands Bay Cave for each package and these results are given in Table 5.4. Andrews results for mandible and incisor loss for the various predator assemblages are listed in Appendix 4, Table 2.

Table 5.4: Mandibular tooth loss

Package	MOLARS					INCISORS			
	No. of Mandibles	No. *in situ* molars	Molar loss a	No. molars expected b	% Molar loss $^a/_b \times 100$	No. *in situ* incisors	Incisor loss a	No. incisors expected b	% Incisor loss $^a/_b \times 100$
1	3	1	8	9	88.8	1	2	3	66.6
2a	9	5	22	27	81.4	4	5	9	55.55
2b	5	4	11	15	73.3	1	4	5	80
3a	61	55	128	183	69.9	16	45	61	73.78
3b	16	13	35	48	72.9	6	10	16	62.5
3c	13	20	19	39	48.7	0	13	13	100
3d	3	2	7	9	77.7	1	2	3	66.66
4a	1	1	2	3	66.6	1	0	1	0
4b	7	1	20	21	95.2	1	6	7	85.71
4c	0								
5a	4	6	6	12	50	0	4	4	100
5b	7	4	17	21	80.9	0	7	7	100
5c	17	14	37	51	72.5	1	16	17	94.11
6	45	33	102	135	75.5	10	35	45	77.77
7a	10	18	12	30	40	0	10	10	100
7b	4	4	8	12	66.6	1	3	4	75
8a	36	28	80	108	74.0	3	33	36	91.66
8b	36	13	95	108	87.9	2	34	36	94.44
9	140	112	308	420	73.3	27	113	140	80.71
10a	8	2	22	24	91.6	2	6	8	75
10b	1	0	3	3	100	0	1	1	100
10c	28	31	53	84	63.0	13	15	28	53.57
10d	7	3	18	21	85.	2	5	7	71.42
11a	108	88	236	324	72.8	37	71	108	65.74
11b	0								
12	5	1	14	15	93.3	0	5	5	100
13	144	109	323	432	74.7	66	78	144	54.16
14	58	56	118	174	67.8	27	31	58	53.44
15a	0								
15b	35	13	92	105	87.6	15	20	35	57.14
15c	24	44	28	72	38.8	16	8	24	33.33
16a	9	4	23	27	85.1	0	9	9	100
16b	1	1	2	3	66.6	0	1	1	100
16c	5	7	8	15	53.3	3	2	5	40
17a	3	0	9	9	100	0	3	3	100
18b	3	2	7	9	77.7	0	3	3	100
19a	6	2	16	18	88.8	0	6	6	100
19b	0								
20a	0								
21c	0								
22a	0								
22b	0								

There is considerable uniformity in the patterning and trends observed in the packages from package 11 to package 16. From this point onwards, to facilitate easy reference, these packages will be referred to as the 'Terminal Pleistocene' packages. The packages from packages 1 to 9 will be referred to as the 'Holocene packages'.

Mandible molar loss is high throughout the site and no clear trends emerge. The fact that there is a uniformly high percentage of molar loss suggests that any patterns that existed at the time of deposition have been subsequently obscured. This loss of patterning could be attributed to the

quite extensive sorting and handling that the micromammal bones from Elands Bay Cave have been subjected to. Mandibular incisor loss shows less uniformity throughout the site than molar loss. Whereas molar loss is generally high, there is a trend towards a lower percentage of incisor loss in the Terminal Pleistocene packages. This suggests better preservation in the cranial bones in the Terminal Pleistocene packages. Table 5.5 shows the maxillary molar loss at Elands Bay Cave.

Table 5.5: Maxillary molar loss

Package	No. of maxillae	No. *in situ* molars	Molar loss a	No. molars expected b	% Molar loss $^{a}/_{b} \times 100$
1	0				
2a	6	8	10	18	55.55
2b	6	5	13	18	72.22
3a	55	62	103	165	62.42
3b	13	13	26	39	66.66
3c	5	3	12	15	80
3d	2	0	6	6	100
4a	2	2	4	6	66.66
4b	4	3	9	12	75
4c	0				
5a	4	3	9	12	75
5b	9	9	18	27	66.66
5c	15	14	31	45	68.88
6	32	13	83	96	86.45
7a	7	9	12	21	57.14
7b	8	4	20	24	83.33
8a	23	17	52	69	75.36
8b	36	15	93	108	86.11
9	112	97	239	336	71.13
10a	3	0	9	9	100
10b	1	0	3	3	100
10c	7	6	15	21	71.42
10d	7	4	17	21	80.95
11a	38	24	90	114	78.94
11b	2	0	6	6	100
12	0				
13	55	26	139	165	84.24
14	26	19	59	78	75.64
15a	0				
15b	11	2	31	33	93.93
15c	17	16	35	51	68.62
16a	5	0	15	15	100
16b	0				
16c	3	6	3	9	33.33
17a	3	0	9	9	100
17b	0				
18a	0				
18b	0				
19a	4	0	12	12	100
19b	0				
20a	0				
21c	0				
22a	1	0	3	3	100
22b	0				

Maxillary molar loss is, like mandible molar loss, uniformly high. This indicates that events subsequent to deposition have distorted the original patterning which existed in the site.

5.2.2 The percentage isolated molars

Table 5.6 below shows the percentage of isolated molars at Elands Bay Cave. Andrews (1990a) calculation of the percentage of isolated molars and incisors may be seen in Appendix 4, Table 3.

Table 5.6: Mandibular and Maxillary isolated molars

Package	Total no. isolated molars a	Mandible and maxilla molar loss b	% Isolated molars $^{a}/_{b} \times 100$
1	0	8	0
2a	1	32	3.12
2b	3	24	12.5
3a	26	231	11.25
3b	13	61	21.31
3c	1	31	3.22
3d	3	13	23.07
4a	2	6	33.33
4b	0	29	0
4c	0	0	-
5a	1	15	6.666
5b	4	35	11.42
5c	3	68	4.411
6	13	185	7.02
7a	9	24	37.5
7b	8	28	28.57
8a	6	132	4.54
8b	17	188	9.04
9	33	547	6.03
10a	3	31	9.67
10b	0	6	0
10c	7	68	10.29
10d	0	35	0
11a	26	326	7.97
11b	0	6	0
12	0	14	0
13	23	462	4.97
14	11	177	6.21
15a	0	0	-
15b	3	123	2.43
15c	6	63	9.52
16a	2	38	5.26
16b	1	2	50
16c	3	11	27.27
17a	1	18	5.55
17b	0	0	-
18a	0	0	-
18b	0	7	0
19a	0	28	0
19b	0	0	-
20a	0	0	-
21c	0	0	-
22a	0	3	0
22b	0	0	-

The uniformity of results seen throughout the site, together with the very low percentages obtained, suggest that there has been some selection against single molars at some stage in the history of the mandibles and maxillae. The sieve sizes used during excavation are likely to have greatly affected the retrieval of the molars during excavation.

5.3 Breakage of molars and incisors

Table 5.7 gives the percentage of broken molars and incisors in the various packages. Table 4 in Appendix 4 records the breakage patterns observed on the molars and incisors from the different predator assemblages (Andrews 1990a).

Table 5.7: Breakage of molars and incisors from the maxilla and mandible

Package	No. *in situ* molars	% *in situ* molars broken	No. isolated molars	% isolated molars broken	% all molars broken	No. *in situ* incisors	% *in situ* incisors broken	No. isolated incisors	% isolated incisors broken	% total incisors broken
1	1	100	0	-	100	1	0	5	20	16.66
2 a	13	0	1	0	0	6	33.33	15	26.66	28.57
2 b	13	0	3	33.33	6.25	2	50	9	33.33	36.36
3 a	117	3.41	26	7.69	4.19	40	15	117	20.51	19.10
3 b	26	15.38	13	61.53	30.76	8	25	18	27.77	26.92
3 c	22	0	1	0	0	0	-	17	17.64	17.64
3 d	2	100	3	33.33	60	1	0	10	30	27.27
4 a	3	33.33	2	50	40	2	50	2	50	50
4 b	4	0	0	-	0	1	0	16	37.5	35.29
4c	0		0			0		0		
5 a	12	41.66	1	0	38.46	2	50	11	45.45	46.15
5 b	13	15.38	4	25	17.64	0	-	6	33.33	33.33
5 c	28	0	3	33.33	3.22	1	0	18	16.66	15.78
6	46	2.17	13	23.07	6.77	14	28.57	52	26.92	27.27
7 a	27	0	9	77.77	19.44	1	100	19	78.94	80
7 b	8	0	8	12.5	6.25	5	80	7	57.14	66.66
8 a	46	6.52	6	16.66	7.69	6	0	58	46.55	42.18
8 b	28	0	17	35.29	13.33	2	100	44	27.27	30.43
9	211	7.10	33	15.15	8.19	39	35.89	134	32.08	32.94
10 a	2	0	3	0	0	4	25	4	25	25
10 b	0	-	0	-	-	0	-	2	0	0
10 c	37	10.81	7	28.57	13.63	14	42.85	18	38.88	40.62
10 d	7	14.28	0	-	14.28	2	100	4	75	83.33
11 a	112	2.67	26	11.53	4.34	59	47.45	62	53.22	50.41
11b	0		0			0		0		
12	4	0	0	-	0	0	-	2	0	0
13	146	4.79	23	13.04	5.91	85	22.35	83	48.19	35.11
14	76	6.57	11	9.09	6.89	35	40	47	42.55	41.46
15 a	0	-	0	-	-	0	-	1	100	100
15 b	21	9.52	3	33.33	12.5	18	11.11	11	54.54	27.58
15 c	34	2.94	5	0	2.56	24	20.83	16	56.25	35
16 a	4	0	1	0	0	0	-	8	50	50
16 b	1	0	1	0	0	0	-	0	-	-
16 c	13	0	3	0	0	7	14.28	6	50	30.76
17 a	0	-	1	0	0	0	-	1	100	100
17 b	0		0			0		0		
18a	0		0			0		0		
18 b	2	50	0	-	50	0	-	1	0	0
19 a	2	0	0	-	0	0	-	5	0	0
19b	0		0			0		0		
20 a	0	-	0	-	-	0	-	1	0	0
21c	0		0			0		0		
22a	0		0			0		0		
22b	0		0			0		0		

The usefulness of the calculation of broken, *in situ* as opposed to broken, single teeth must be questioned in the light of the evidence that there has been considerable loss of teeth from mandibles and maxillae since deposition. No clear trends emerge from the percentages of broken teeth. Packages 7b and 10d stand out as having a relatively high percentage of broken incisors and 3b has a high proportion of broken molars. Sample size is unsatisfactory for the latter.

5.4 Relative proportions of postcranial elements

Andrews (1990) checked for selection for proximal, as opposed to distal, elements and for post-cranial or cranial bones, his results may be seen in Appendix 4, Table 5 and Table 6. Table 5.8 below gives the results obtained from the Elands Bay Cave assemblage.

Table 5.8: The proportion of postcranial to cranial and proximal to distal elements

Package	Total No. of mandibles & maxilla	Total No. of femora & humeri	Total No. of tibiae & ulnae	% femur + humerus / mandible + maxilla	% tibia + ulna / femur + humerus
1	3	1	1	33.33	100
2a	15	12	6	80	50
2b	11	11	4	100	36.36
3a	116	131	61	112.93	46.56
3b	29	25	8	86.20	32
3c	18	8	3	44.44	37.5
3d	5	6	0	120	0
4a	3	0	1	0	-
4b	11	2	3	18.18	150
4c	0	0	1	-	-
5a	8	13	5	162.5	38.46
5b	16	0	0	-	-
5c	32	19	6	59.37	31.57
6	77	49	25	63.63	51.02
7a	17	7	2	41.17	28.57
7b	12	3	5	25	166.66
8a	59	88	38	149.15	43.18
8b	72	64	35	88.88	54.68
9	252	202	79	80.15	39.10
10a	11	5	5	45.454	100
10b	2	5	5	250	100
10c	35	21	9	60	42.85
10d	14	15	10	107.14	66.66
11a	146	32	30	21.91	93.75
11b	2	2	0	100	0
12	5	3	1	60	33.33
13	199	98	75	49.24	76.53
14	84	12	18	14.28	150
15a	0	3	0	-	0
15b	46	70	18	152.17	25.71
15c	41	7	9	17.07	128.57
16a	14	19	5	135.71	26.31
16b	1	1	0	100	0
16c	8	24	5	300	20.83
17a	6	8	6	133.33	75
17b	0	1	0	-	0
18a	0	3	1	-	33.33
18b	3	1	4	33.33	400
19a	10	16	5	160	31.25
19b	0	1	0	-	0
20a	0	1	1	-	100
21c	0	0	0	-	-
22	1	1	0	100	0
22b	0	0	0	-	-

The results for the proportions of cranial to postcranial and proximal to distal bones is extremely variable throughout the site. Packages 4b, 7b, 14 and 15c show a marked surplus of mandibles and maxillae. Interestingly, it is also only these packages that have a surplus of distal limb bones. Package 11a also has a large surplus of mandibles and maxillae but does not have a surplus of distal bones, though there is a near equivalence in the number of tibiae and ulnae and

femora and humeri. The surplus of distal limb bones in 4b, 7b, 14 and 15c may indicate that there is slightly better preservation in these packages as the distal bones are more vulnerable to damage than the proximal bones (Andrews 1990a). Other packages, such as 3c, 7a, 10a and 13 also show a surplus of cranial bones, (though not such a marked one as 4b, 7b, 14 and 15c) but show no corresponding surplus of distal limb bones.

5.5 Breakage patterns of the long bones

Table 5.9 shows the breakage patterns of the long bones at Elands Bay Cave. The total number of each long bone is given for each package and this is followed by the total percentage of the long bones falling into the complete, proximal, distal or shaft categories. The results for long bone breakage are more clearly illustrated by Figures 5.1-5.9, which follow after Table 5.9. Andrews' (1990a) results for the different predator assemblages may be seen in Appendix 4, Table 6.

Table 5.9: The breakage patterns of the limb bones

Package	FEMORA					TIBIAE				
	TOTAL NO. OF FEMORA IN PACKAGE	% complete	% proximal	% distal	% shaft	TOTAL NO. OF TIBIAE IN PACKAGE	% complete	% proximal	% distal	% shaft
1	1		100			1			100	
2 a	5	20	60	20		5		20	60	20
2 b	6		66.7	33.3		4			100	
3 a	77	7.79	64.9	27.3		44	6.8	31.8	47.7	13.6
3 b	8	12.5	87.5			5			80	20
3 c	6		66.7	33.3		1		100		
3 d	3	33.3	66.7			0				
4 a	0					1			100	
4 b	0					1		100		
4 c	0					1			100	
5 a	4		75	25		1			100	
5 b	0					0				
5 c	11	18.18	36.4	45.5		2		50	50	
6	26	7.69	65.4	23	3.8	21	28.5	9.5	42.8	19
7 a	4		75	25		2		50	50	
7 b	3	33.3	66.7			4		25	75	
8 a	50	22	60	18		29	24.1	17.2	48.3	10.34
8 b	34	8.82	44.1	47		30	6.66	30	56.7	6.66
9	101	2.97	77.2	18.8	0.9	54	5.55	33.3	59.2	1.85
10 a	3	33.3	33.3	33.3		5		40	40	20
10 b	3	33.3	66.7			4			100	
10 c	14	50	35.7	14.2		6	16.6		66.7	16.6
10 d	10	70	30			10	40		60	
11 a	20	65	30	5		26	30.76	23	38	7.6
11 b	2	50	50			0				
12	3	33.3	66.7			0				
13	61	49.18	31.14	19.7		62	22.58	22.6	48.4	6.45
14	8	75		25		12	8.3	33.3	58.3	
15 a	2	50	50			0				
15 b	42	40.47	54.8	4.8		14	35.7		64.3	
15 c	5	60	40			9	22.2	44.4	22.2	11.1
16 a	15	20	60	20		4	25	50	25	
16 b	1	100				0				
16 c	20	60	30	10		5	20		60	20
17 a	6	33.3	66.6			6	16.67	16.7	66.7	
17 b	1		100			0				
18 a	1		100			1			100	
18 b	0					3		66.7	33.3	
19 a	10	20	70	10		3	33.3		66.7	
19 b	0					0				
20 a	1		100			1			100	
21 c	0					0				
22 a	1		100			0				
22 b	0					0				

Table 5.9: Cont...

Package	TOTAL NO. OF HUMERI IN PACKAGE	HUMERI % complete	% proximal	% distal	% shaft	TOTAL NO. OF ULNAE IN PACKAGE*	ULNAE % complete	% proximal	TOTAL NO. OF RADII IN PACKAGE*	RADII % complete	% proximal
1	0					0			0		
2 a	7	42.8	14.3	42.8		1	100		0		
2 b	5	60		40		0			0		
3 a	54	16.5	13	68.5		17	41.17	58.8	5	40	60
3 b	17	17.6	11.8	70.6		3		100	0		
3 c	2	50		50		2	50	50	0		
3 d	3		33.3	66.7		0			1	100	
4 a	0					0			0		
4 b	2	50		50		2		100	0		
4 c	0					0			0		
5 a	9	11.1		88.9		4	75	25	0		
5 b	0					0			1	100	
5 c	8	12.5		87.5		4	25	75	0		
6	23	8.7	34.8	56.5		4	25	75	1	100	
7 a	3		33.3	66.7		0			0		
7 b	0					1	100		1		100
8 a	38	23.68	15.8	60.5		9	22.2	77.7	2	50	50
8 b	30	10	10	80		5	20	80	0		
9	101	10.89	19.8	69.3		25	12	88	0		
10 a	2	50	50			0			0		
10 b	2			100		1	100		0		
10 c	7	57		42.9		3		100	1	100	
10 d	5	80	20			0			0		
11 a	12	50	16.7	33.3		4	25	75	2	50	50
11 b	0					0			0		
12	0					1	100		0		
13	37	56.75	18.9	24.3		13	15.38	84.6	2	50	50
14	4	50		50		6		100	3	100	
15 a	1			100		0			0		
15 b	28	53.5	10.7	32	3.5	4	25	75	0		
15 c	2	100				0			0		
16 a	4	50		25	25	1		100	0		
16 b	0					0			0		
16 c	4	50		50		0			0		
17 a	2	100				0			0		
17 b	0					0			0		
18 a	2			100		0			0		
18 b	1			100		1	100		0		
19 a	6	16.7		83.3		2		100	1	100	
19 b	1		100			0			0		
20 a	0					0			0		
21 c	0					0			0		
22 a	0					0			0		
22 b	0					0			0		

* No shaft or distal portions of ulnae or radii were found in Elands Bay Cave

Figure 5.1 shows the percentage of complete and proximal femurs throughout the site. There is a marked increase in the number of complete femora from packages 10a to 16c, which appears to mark the start of a general change in completeness between the Terminal Pleistocene and Holocene packages in the site (see Fig. 5.1 below). Package 19a (n=10) diverges from the general Terminal Pleistocene pattern with rather lower levels of completeness. There are more proximal femurs found in the packages from the Holocene, reflecting the greater breakage in this half of the site. Andrews (1990a) notes that trampling leads to an increase in the number of proximal femora and distal humeri in a site.

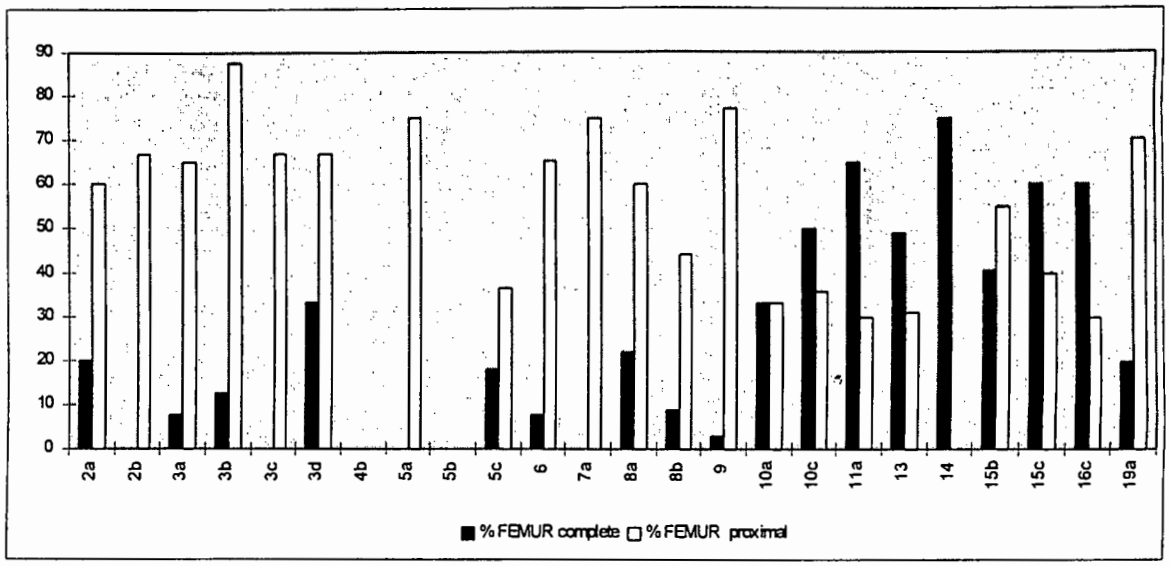

Figure 5.1: Relative completeness of the femur (proximal)

A comparison between femur completeness and the morphologically less robust distal femur (figure 5.2) fails to show the differences in completeness between the two groups of packages in the site that was shown by the more robust proximal femur. This indicates that post-depositional breakage may have obscured the predator-induced breakage patterns of the distal femur.

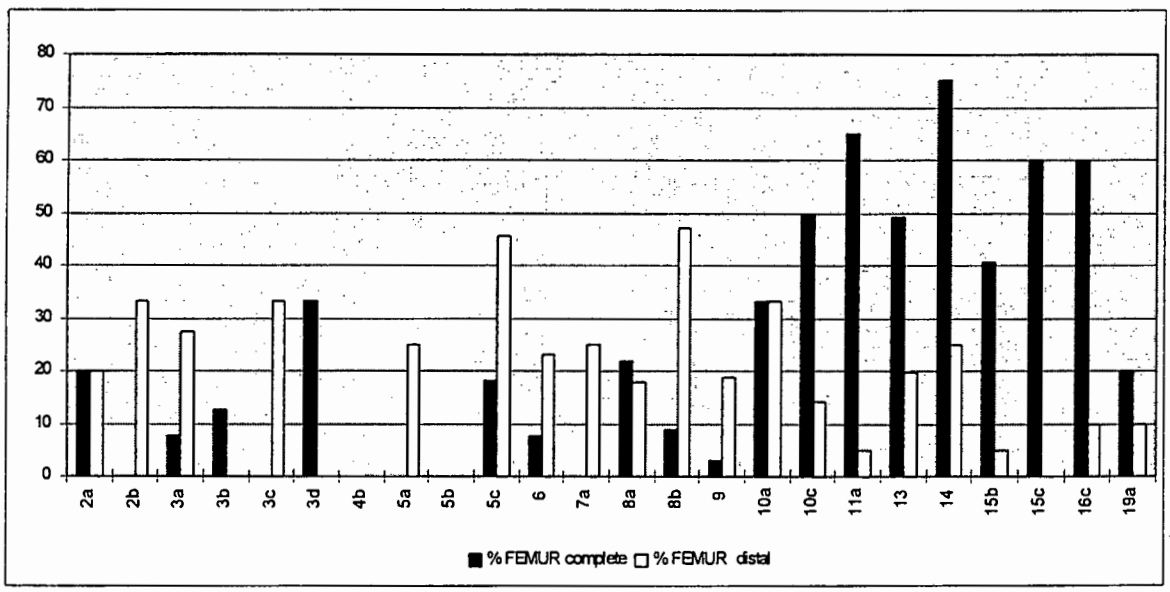

Figure 5.2: Relative completeness of the femur (distal)

Figure 5.3 shows that in the Terminal Pleistocene levels there is a marked increase in the completeness of the humeri, this change occurs in the same package as does femur completeness. Package 19a once again shows low levels of completeness. There is no obvious patterning in the proximal humeri and they are found in low proportions throughout the site. Packages 2a (n=7), 2b (n=6), 3c (n=2) and 4b (n=2) show somewhat higher levels of completeness than the surrounding Holocene packages but are unreliable in that this percentage is based upon a relatively small number of humeri.

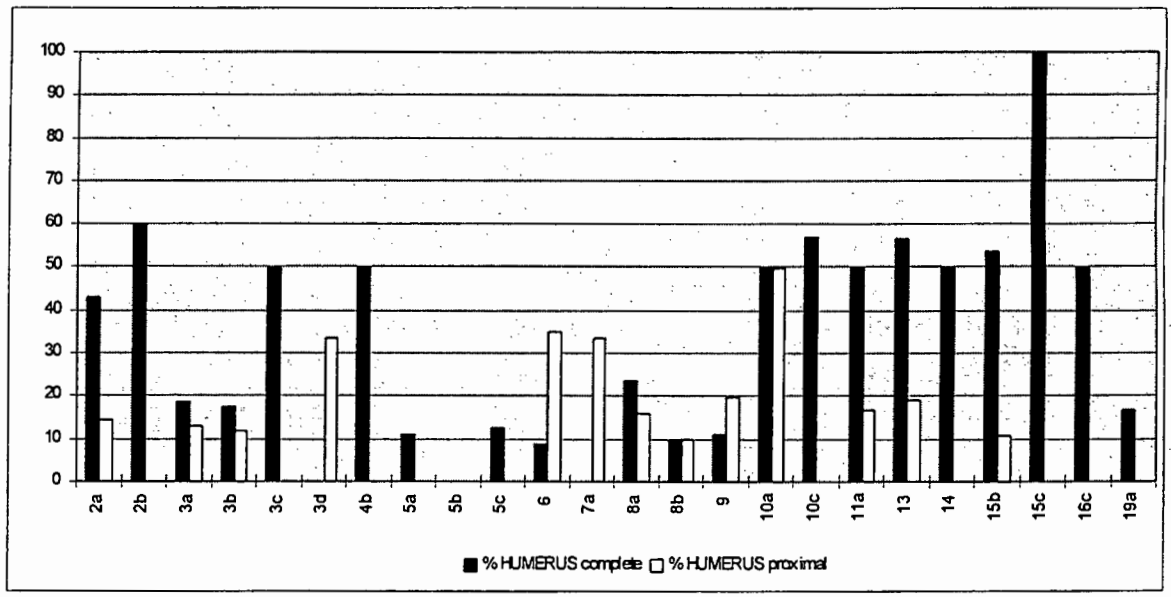

Figure 5.3: : Relative completeness of the humerus (proximal)

As may be seen in Figure 5.4, the robust distal humerus, like the proximal femur, is more abundant in the Holocene packages where there are lower levels of completeness. Package 19a is, once again, somewhat of an anomaly in the lower part of the site with low levels of completeness and a high percentage of distal humeri, similar to that seen in packages 3a to 9.

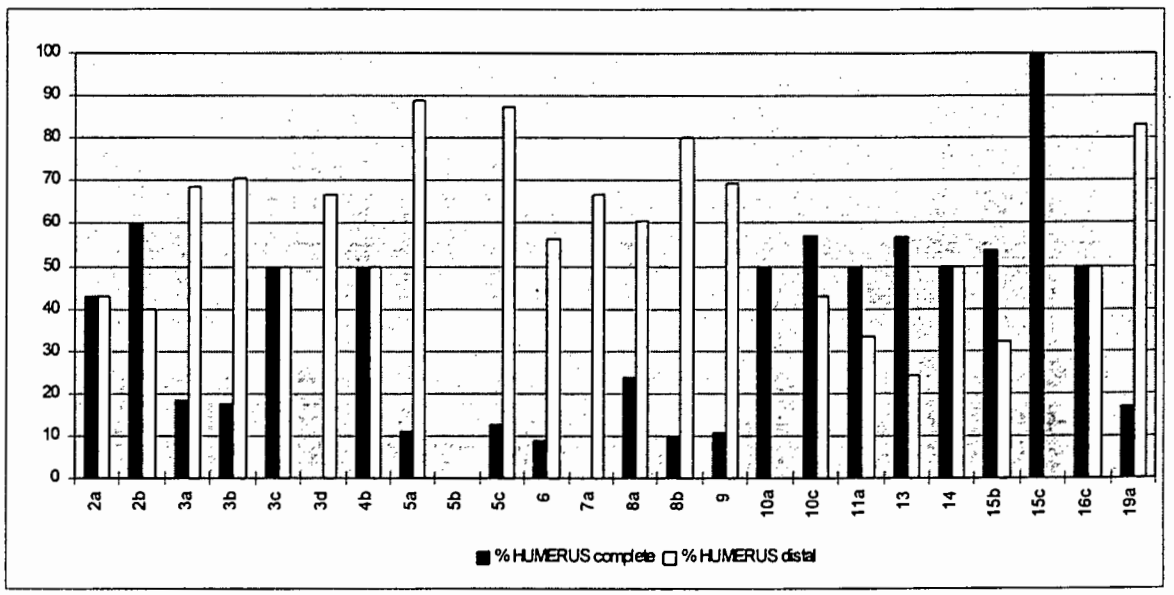

Figure 5.4: Relative completeness of the humerus (distal)

Tibia completeness (figure 5.5) fluctuates over the site and does not show the marked change in completeness shown by the femur and humerus, though there is an increase in complete tibiae in the Terminal Pleistocene packages. The percentage of proximal tibiae and distal tibiae (figure 5.6) does not show any specific pattern but fluctuates over the site. The tibia yielded the highest number of shafts of all the long bones and these were found mainly in small proportions throughout the site, with more of the Terminal Pleistocene packages in the site containing shafts, probably reflecting the lower levels of breakage in these packages.

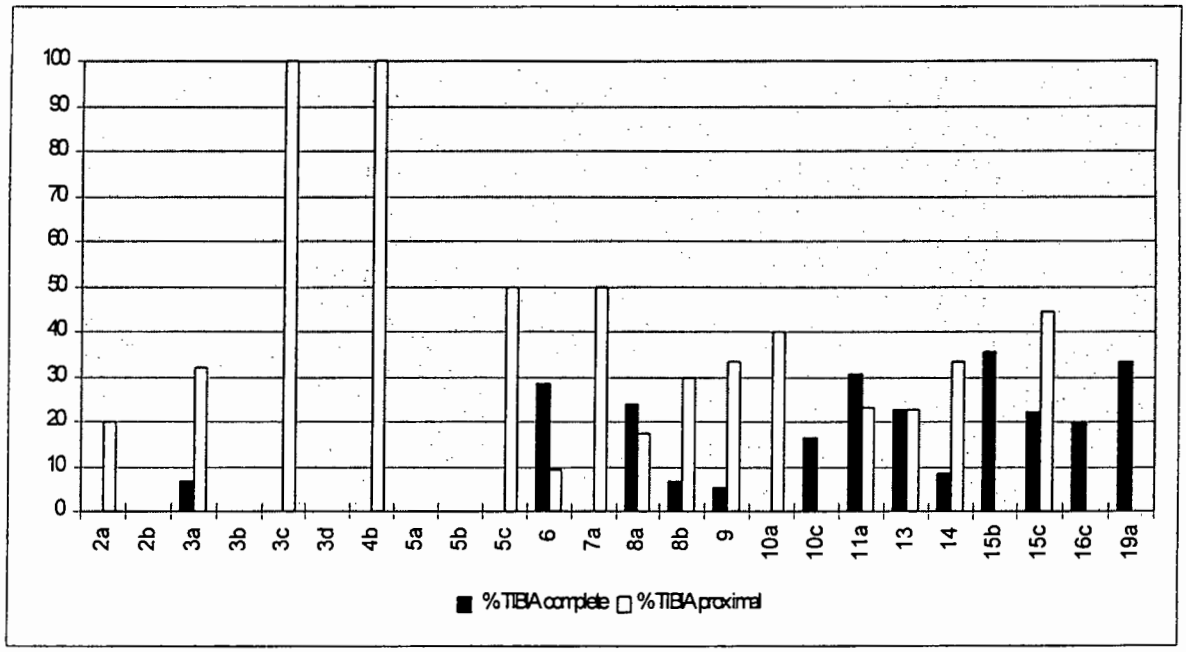

Figure 5.5: Relative completeness of the tibia (proximal)

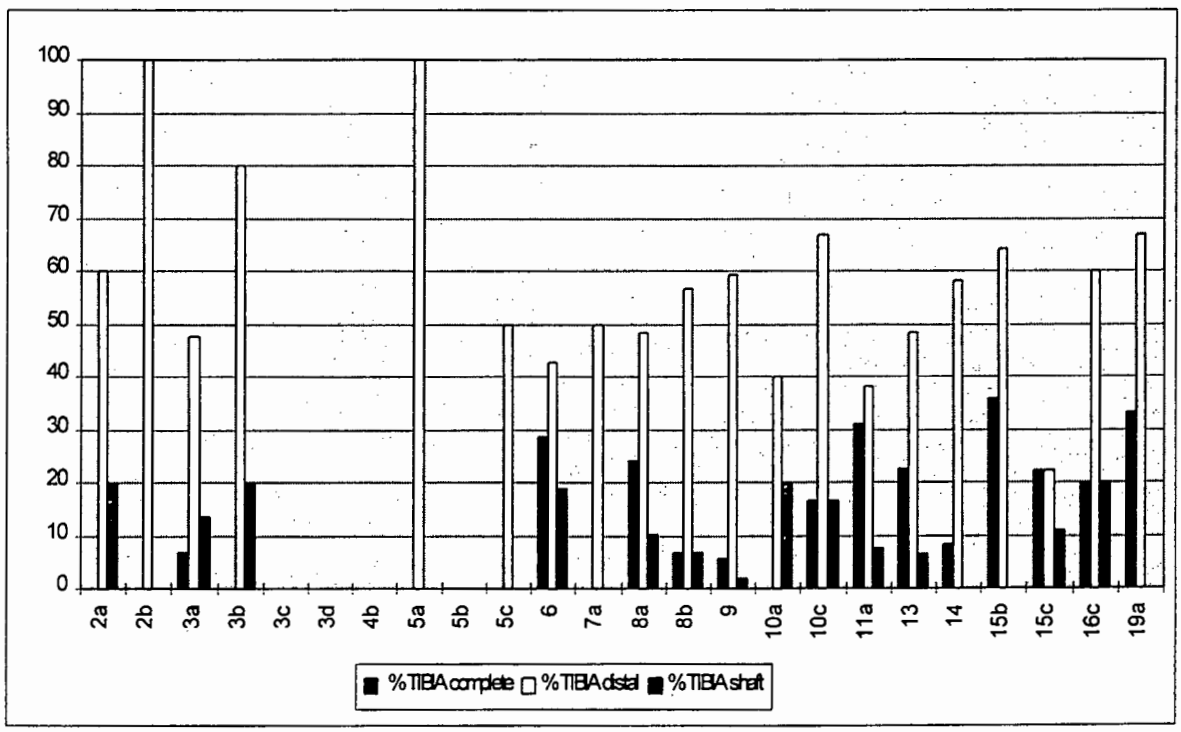

Figure 5.6: Relative completeness of the tibia (distal and shaft)

Ulna completeness is, unlike the other long bones, higher in the Holocene packages of the site. The number of proximal ulnae fluctuates throughout the site and no clear patterning in their distribution may be observed.

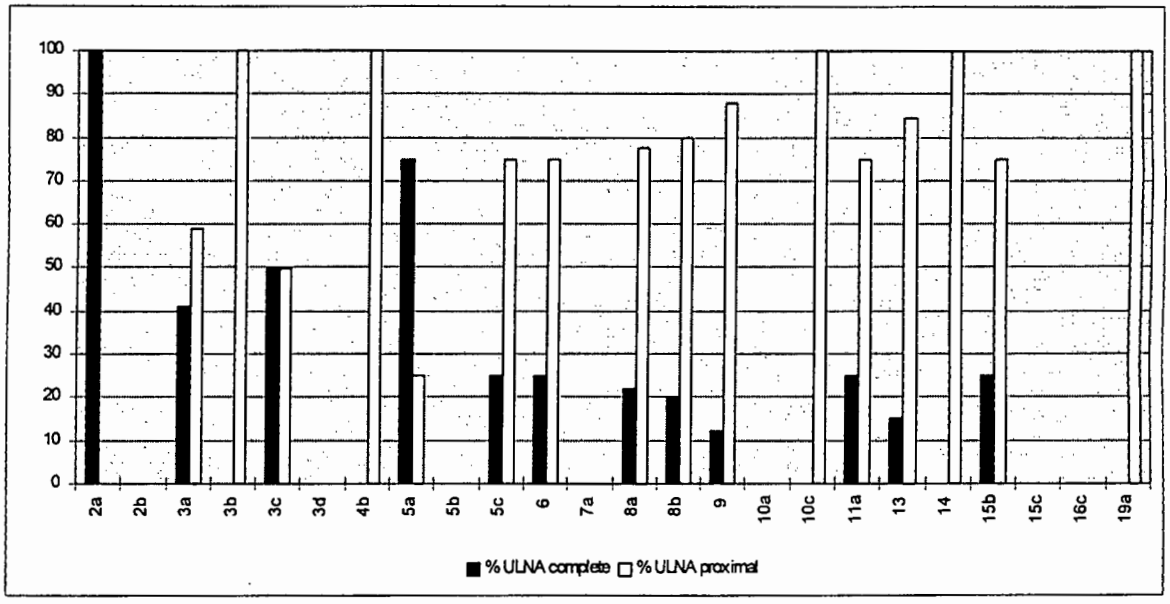

Figure 5.7: Relative completeness of the ulna (proximal)

Andrews did not look at the breakage patterns of the fragile radii, very few of which were found in the Elands Bay assemblage. No distal radii or ulnae or radii and ulnae shafts were found on the site.

5.6 Incisor digestion

5.6.1 The area of etching on incisor enamel

An investigation of the area in which the enamel was etched indicated that incisors were predominantly etched on the tip. Packages 1, 2a, 2b, 3a, 3c, 4a, 4b, 5a, 5b, 8b, 10a, 10c, 12, 13, 14, 18b and 19a all show etching on the enamel at the tip of 80 - 100% of the etched incisors analysed. The only packages that don't contain incisors that are predominantly etched on the tips were packages 3d, 10b and 11a, which contained incisors which were etched at the side and tip.

The presence of small, clear salt crystals and manganese staining was observed to be present on many of the mandibles and maxillae in the packages throughout the site - there was, however, no marked patterning in the occurrence of these features throughout the site. Hairline or open cracks in the enamel or dentine of the incisors were observed throughout the site with all

packages showing some cracking in the dentine of the incisors. Cracking of the enamel was more rare but also did not appear in any specific section of the site.

5.6.2 The degree of enamel digestion

The degree of enamel etching on the incisors was recorded. Category 1 was the category containing the most mildly etched incisors and category 4, the most extreme. The percentage of etched incisors falling into each category may be seen below in figure 5.8.

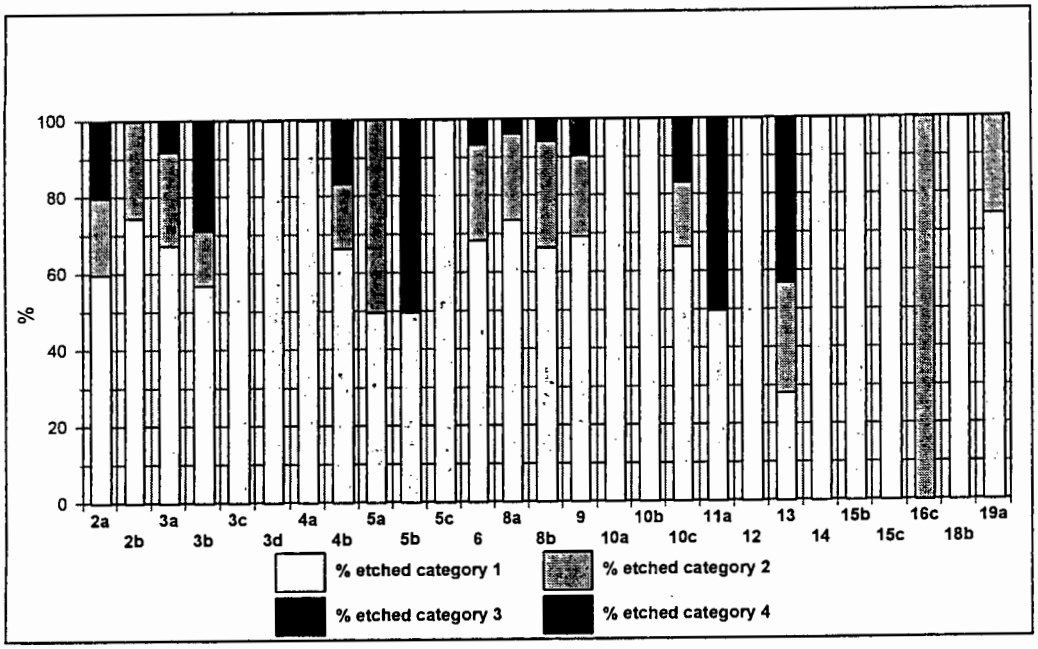

Figure 5.8: Percentage representation of enamel etching categories in various packages

Only one incisor fell into category 4 and this incisor was found in package 9. The degree of etching follows no fixed pattern in the site, with the majority of the packages containing incisors which were only slightly etched, that is, incisors belonging to category 1.

Packages 5b, 11a and 13 contain a relatively high percentage of incisors with category 3 etching, however, the incisor sample involved here is relatively small, n= 4, n=2 and n=7, respectively. Sample size is also negligible in package 16c where n=1. The Terminal Pleistocene packages contained very few etched incisors so the sample size for these packages is very small.

5.6.3 Patterning of incisor etching

In table 5.10 are listed the Elands Bay Cave packages containing 'recordable' incisors. The number of recordable incisors is the number of incisors that were sufficiently whole to identify whether or not etching was present on the tooth. The other two columns record the percentage of incisors which show etching of the enamel and dentine.

Table 5.10: Percentage of incisors showing etching of the enamel and dentine

Package	No. of recordable incisors	% enamel etching	% dentine etching
1	3	33	100
2a	18	55.5	80
2b	6	66.6	71.42
3a	139	62.58	81.15
3b	16	43.75	84.7
3c	16	43.75	68.75
3d	9	11	50
4a	3	33.3	50
4b	13	46.15	76.92
4c	0	-	-
5a	7	57.14	66.6
5b	5	40	75
5c	19	21	75
6	41	39	81.1
7a	7	0	0
7b	4	0	0
8a	52	51.9	72
8b	32	56.25	84.37
9	129	66.66	73.6
10a	9	11.1	100
10b	2	100	100
10c	10	80	80
10d	2	0	0
11a	70	2.85	3.12
11b	0	-	-
12	2	50	50
13	114	6.14	7
14	50	6	8
15a	0	-	-
15b	26	15.38	11.53
15c	32	3.12	0
16a	2	0	0
16b	0	-	-
16c	8	12.5	14.28
17a	0	-	-
17b	0	-	-
18a	0	-	-
18b	1	100	100
19a	5	80	80
20a	1	0	0
21c	0	-	-
22a	0	-	-

Some of the packages from table 5.10 are shown below in figure 5.9. Only those containing more than 5 recordable incisors are illustrated in order to eliminate the smallest samples which, due to their size, may be unreliable indicators. Many of the other packages in figure 5.9 contain unsatisfactory sample sizes but are included as they provide information on how the small sized samples fit into the general picture. Packages 3d, 7a and 10a, which contain small samples, show the most marked deviation from the general trend shown by surrounding packages.

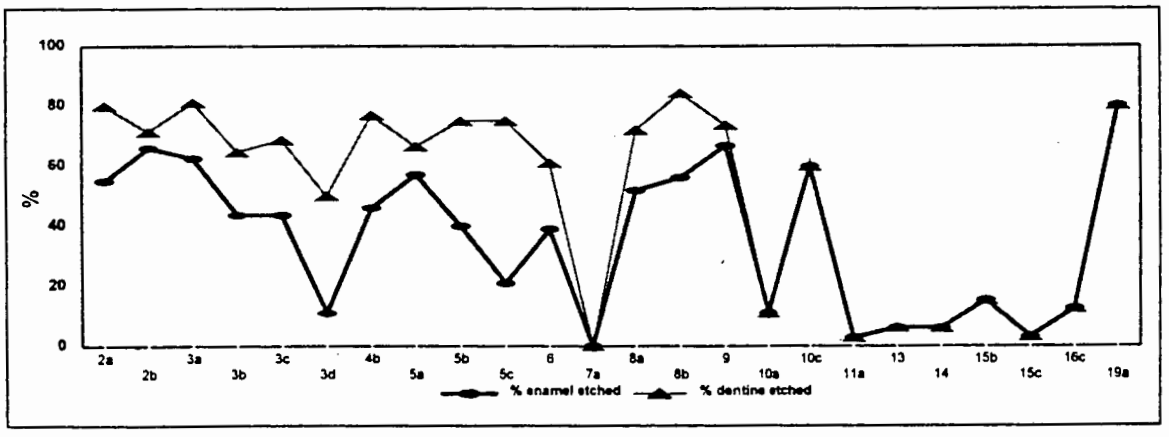

Figure 5.9: Incisor etching: Enamel and dentine

There are differences between the Terminal Pleistocene and Holocene packages of the site in the etching of both enamel and dentine. The etching of both enamel and dentine in packages 2a to 9 fluctuates, and, with the exceptions of packages 3d (n=9), 5c (n=19) and 7a (n=7), generally shows a considerably higher percentage of incisor etching than the packages from 11a and below (excluding package 19a) which show a markedly uniform pattern of both enamel and dentine etching. The pattern of dentine etching in the Holocene packages was different to that of the Terminal Pleistocene packages in that the dentine was etched far more than the enamel. In the Terminal Pleistocene packages, however, the percentage of etched dentine and enamel is almost the same. Package 19a has levels of etching comparable to that seen in the Holocene packages and, as was seen earlier, the breakage patterns of the humerus and femur also suggest that package 19a is similar to the Holocene, rather than the Terminal Pleistocene, packages.

5.6.4 Completeness of the long bones

Figure 5.10 below compares the percentage completeness of the humerus and femur. All of the Holocene packages containing relatively large accumulations of micromammal bones are clustered around the origin, as are some of the smaller Holocene packages, indicating low levels of completeness for both humeri and femora. In order to clarify the differentiation between the two patterns seen in the site (the Holocene packages show low levels of completeness of the femur and humerus while the Terminal Pleistocene packages show high levels of completeness), the packages containing a total of more than 14 femora and humeri (packages 3a, 3b, 5c, 6, 8a, 8b, 9, 10c, 10d, 11a, 13, 15b, 16a, 16c, 19a) were marked in red in order to differentiate them from the packages containing smaller samples which might be unreliable indicators.

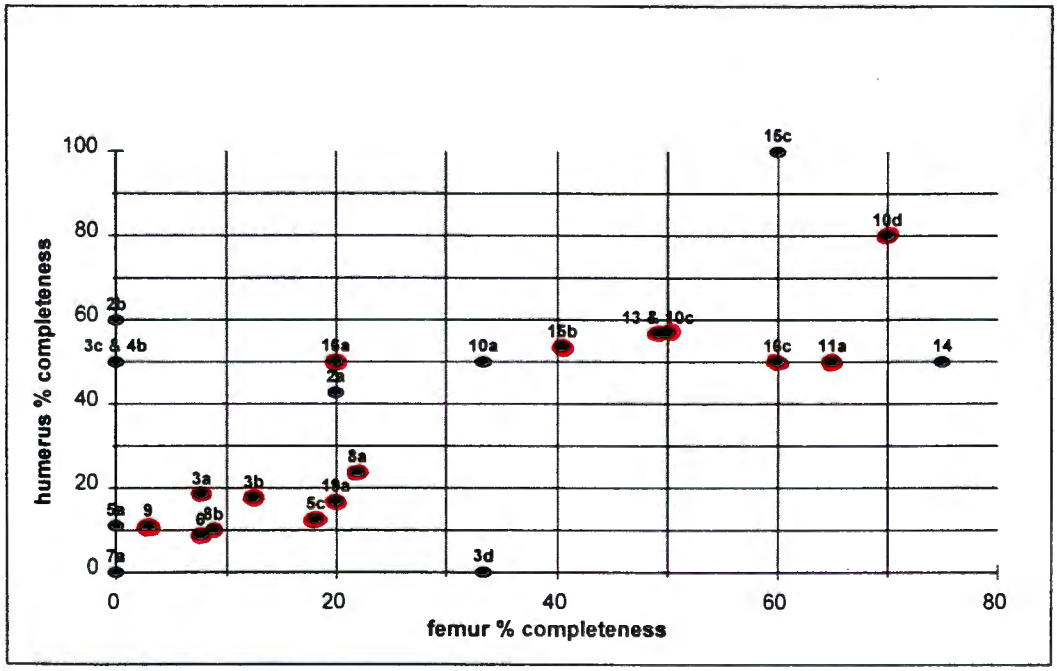

Figure 5.10: Completeness of the femur and humerus

5.6.5 Incisor etching as compared to completeness of the femur and humerus

Figure 5.11 and 5.12 below shows the relationship between percentage completeness of the femur and humerus and the incisor etching in the different packages. The packages containing more than 13 recordable incisors (packages 2a, 3a, 3b, 3c, 5c, 6, 8a, 8b, 9, 11a, 13, 14, 15b, 15c) were marked in red in order to differentiate them from the packages containing small numbers of incisors which may be unreliable indicators. Package 4b contained no femora and does not therefore appear on the graph below. Apart from a few packages, incisor etching and femur completeness separates out the Holocene and Terminal Pleistocene packages.

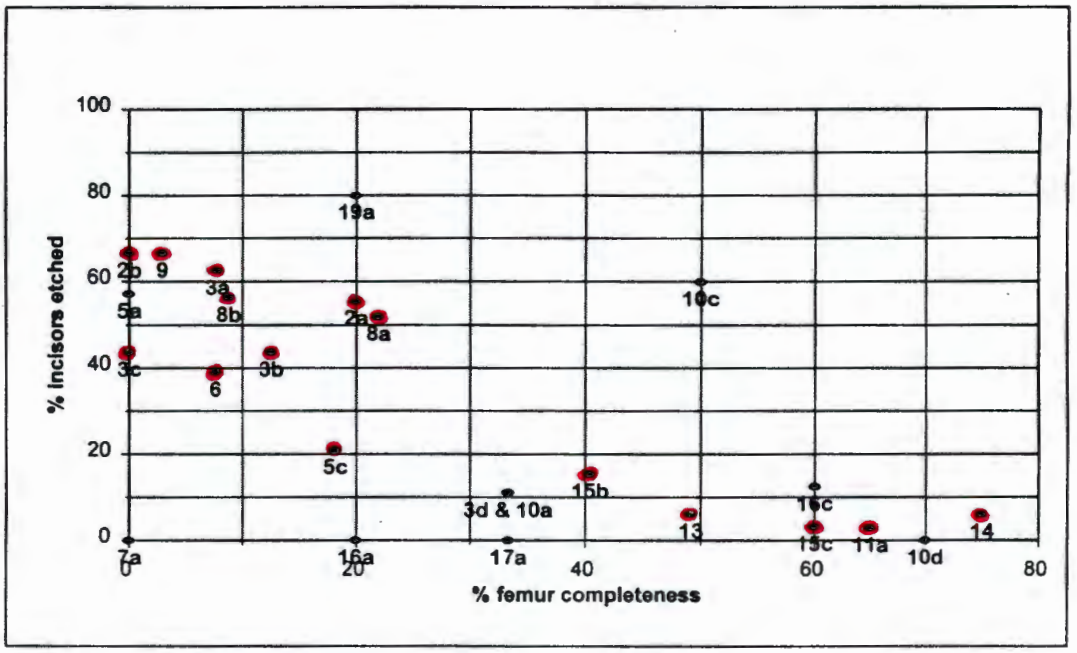

Figure 5.11: Completeness vs etching: The femur

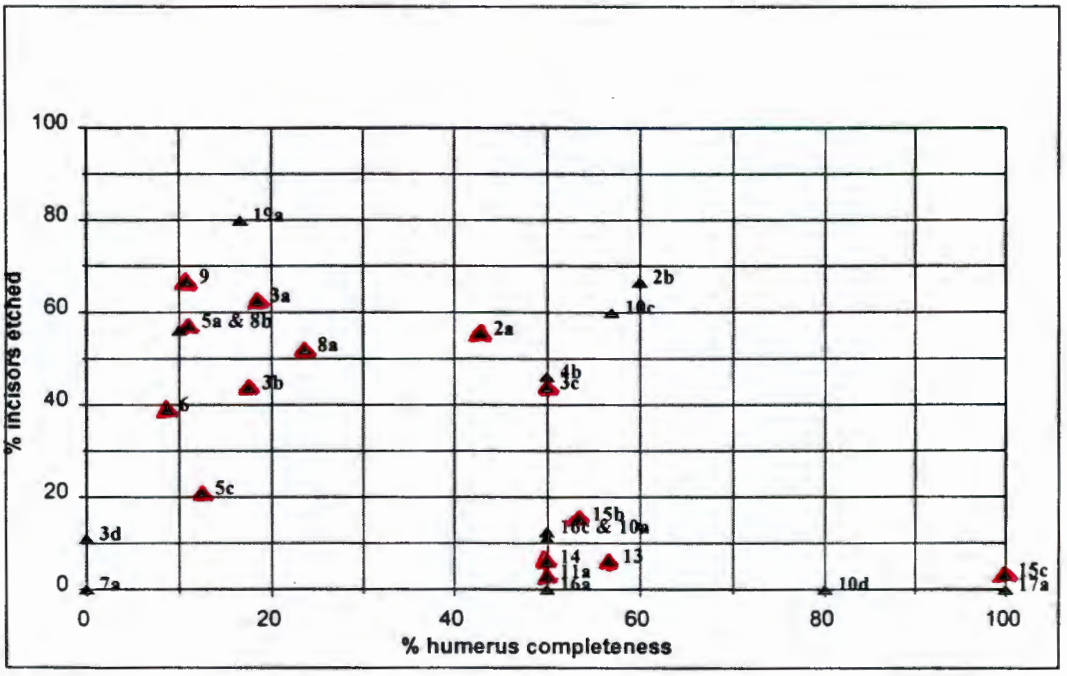

Figure 5.12: Completeness vs etching: The Humerus

The variability in the percentage of etched incisors and in percentage completeness of the humerus in the Holocene packages is far greater than that of the Terminal Pleistocene packages. The Terminal Pleistocene packages show a remarkably uniform pattern of etching and breakage for the humerus, with all of the packages that clustered together in the previous graph appearing even more tightly grouped.

5.7 Investigating the dense accumulations of micromammals on the site

Table 5.11: Percentage of etched incisors in the packages containing relatively dense accumulations of micromammal bone

Units containing ≥ 5g/m³ of micromammal bone and 5 or more buckets of deposit	Package	Total % of etched incisors (Number of recordable incisors in brackets)
MOBU	2b	80 (n=5)
BARN BEDP DOLL DOL2 DOSU SDUN SURF	3a	62.58 (n=139)
GEGR EVGO LARM	5c	21.05 (n=19)
GASO GSFB RING NYER	6	32 (n=25)
MAJI RETS	7a	0 (n=6)
RADS	7b	0 (n=2)
JOFR JOFR2 BSJF LSBL	8a	56.25 (n=48)
DBRA OBOT SOYI	8b	53.33 (n=30)
NEFE TUTA WAYO	9	72.34 (n=94)
EUSE	10c	0 (n=3)
BETT	10d	- no recordable incisors
HOLE BSAN MUSO SLOP SOIL SOSU SOME	11a	2.85 (n=70)
BSBP BSP1 BSP2 BLEN BURN GONE LIMP NEPT SOLE YASM ZOST	13	5.49 (n=91)
CRAB CRAY FLIP LOBS	14	7..31 (n=41)
ASHE STRA	15b	0 (n=1)
BEFO FORE	15c	3.12 (n=32)
GB1A	16c	0 (n=2)
BGBS	17a	- no recordable incisors

An attempt was made to try and ascertain whether the trends observed in certain packages were retained when the units within those packages containing relatively dense concentrations of micromammals were added together and analysed separately. Table 5.11 lists the individual units containing $\geq 5g/m^3$ of microfauna and 5 or more buckets of deposit, the package to which they belong, and, in brackets, the number of recordable incisors showing evidence of etching.

Figure 5.13 below illustrates the percentage etching of the units containing relatively dense accumulations of micromammal bone as compared with the etching pattern obtained from the total packages, which contained units which contained both dense and relatively sparse accumulations of micromammal bone. Figure 5.13 illustrates that the etching patterns obtained when looking at only the microfaunally dense units are very similar to those obtained when looking at all the units in a package.

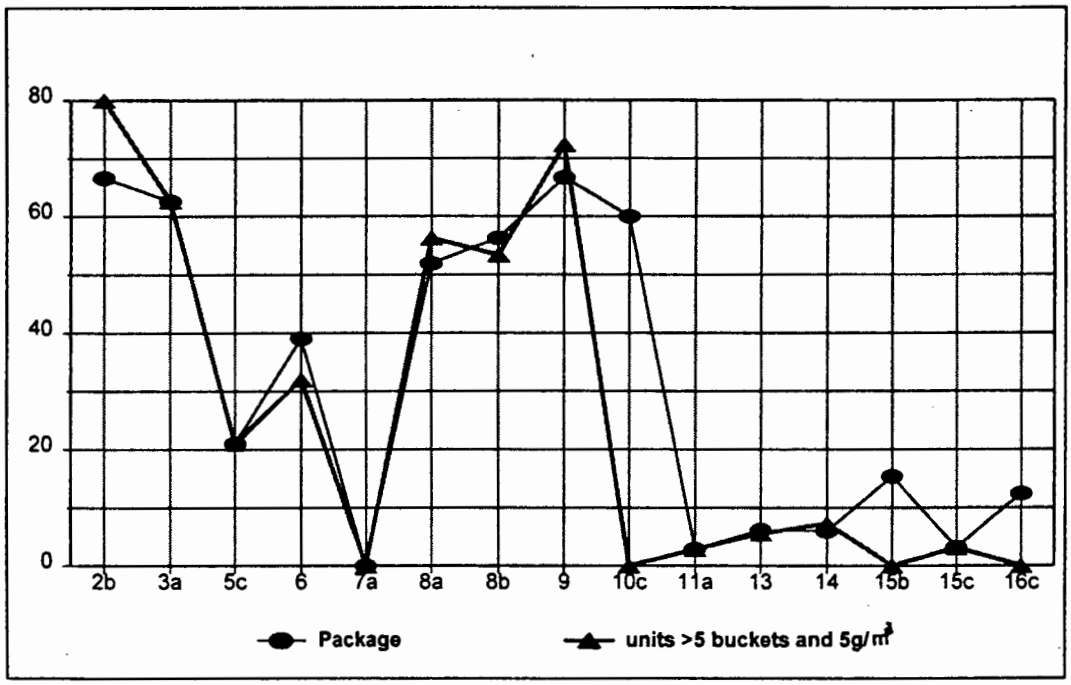

Figure 5.13: Etching of the entire package vs the etching in the units containing dense accumulations of micromammal bone

Figure 5.14 shows the pattern of femur and humerus completeness in the site in only the microfaunally dense units. In some of the packages seen in figure 5.14, the number of femora and humeri (the number of long bones is seen above the relevant column) are the same, or almost the same, as the numbers of femora and humeri in the total packages seen in Table 5.9. In packages where there are many units which contain low concentrations of micromammal bone, however, the number of femora and humeri is considerably lower, reflecting the fact that most of the humeri and femora in those packages were found in units where there was a low density of micromammal bone. The pattern of femora and humeri completeness in the microfaunally dense packages of the site is very similar to that obtained from the whole

packages (see figs. 5.1 to 5.4), with higher levels of completeness seen in both the femora and humeri in the Terminal Pleistocene packages. The results seen in figures 5.13 and 5.14 for incisor etching and long bone completeness is encouraging as it indicates that resolution has not been lost in using packages, as opposed to units, for analysis.

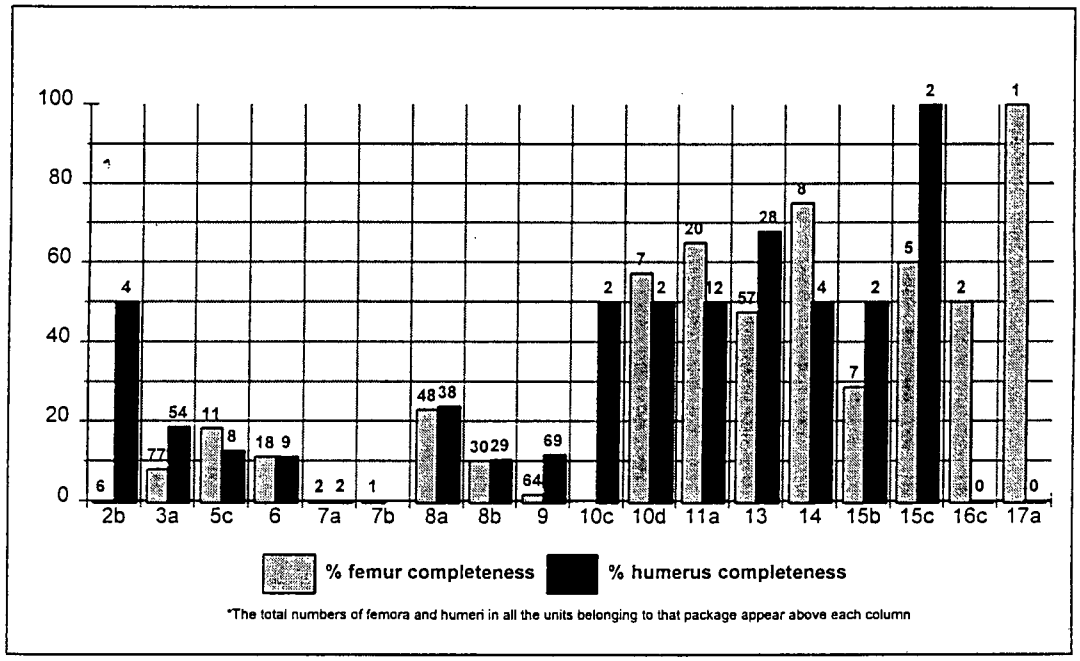

Figure 5.14: Completeness of the femur and humerus in the units containing dense accumulations of micromammal bone

5.8 The micromammals at Elands Bay Cave and environmental change

Avery (in prep) studied the microfaunal remains from Elands Bay Cave in order to ascertain changes in climate and vegetation over the time period the microfaunal assemblages were deposited. The percentage representation of rodent and insectivore species, as set out by Avery (in prep), was examined to see if the divisions between the Terminal Pleistocene and Holocene packages(as seen in the incisor etching and in the breakage of long bones) was reflected in the percentage representation of the different species on the site. Avery (draft paper) added together several packages and sub-packages for the purposes of analysis of the Elands Bay micromammals. For example, in Table 5.11 below, where the packages are listed as 1-2b, this indicates that packages 1, 2a and 2b were added together for the purposes of analysis.

Packages 15-19, which were added together by Avery for the purposes of analysis, appear different to any of the other packages on the site. Packages 1-2b, 3a-4c, 5a-5c, 6-7, 8 and 9 show a very different pattern of species representation to packages 10a-10d, 11-12, 13 and 14. The dotted lines seen in Table 5.11 have been inserted to indicate where the changes in the percentage representation of several species occur and where it appears that these trends are occurring overall in the site.

The following differences were observed between the Holocene packages (1-2b, 3a-4c, 5a-5c, 6-7, 8 ,9), the Terminal Pleistocene packages (10a-10d, 11-12, 13, 14), and packages 15-19, in the percentage representation of the micromammals at Elands Bay Cave; the Bush Karoo rat (*O. unisulcatus*) showed a marked increase in frequency in the Terminal Pleistocene levels (with the exception of amalgamated packages 15-19), as compared to the Holocene packages. The Namaqua rock rat (*A. namaquensis*) shows a change in percentage representation at exactly the same place, only this time the percentage representation of this species is far greater in the Holocene packages. Two other species of *Otomys* appear mainly in the Holocene packages of the site, namely, Saunders vlei rat (*O. saundersae*) and the Vlei rat (*O. irroratus*). Once again packages 15-19 appear different to the other Terminal Pleistocene levels. Krebs fat mouse (*S. krebsii*) appears only in the Holocene packages and in packages 15 to 19. The Cape gerbil (*T. afra*) and the Hairy footed Gerbil (*G. paeba*) occur in lower and higher frequencies in the Holocene and Terminal Pleistocene packages, respectively. The Pygmy mouse (*Mus minutoides*) and Verreaux's Mouse (*Praomys verreauxii*) appear almost entirely in the Holocene packages. The shrews, *Elephantulus rupestris, Myosorex varius, Elephantulus edwardii, Suncus varilla, Crocidura flavescens* and *Crocidura cyanea* are far better represented in the Holocene packages. The Striped field mouse (*Rhabdomys pumilio*) and the Common molerat (*Cryptomus hottentotus*) are notable in that they appear in most of the packages throughout the site. More species are represented overall in the Holocene as compared to the Terminal Pleistocene packages, packages 10, 11, 12, 13 and 14. Table 5.11 shows that the differences between the Terminal Pleistocene and Holocene packages (as seen in the incisor etching and in the breakage of long bones) was reflected in the percentage representation of the different micromammal species on the site. The percentage representation of the micromammal species in packages 15, 16, 17, 18 and 19 (which have been added together for the purposes of analysis (Avery draft paper) differs to that of the other Terminal Pleistocene packages. It is possible that the differences observed may have resulted from the mixing of packages from different predators, as the etching and breakage patterns observed in package 19 indicate that this package was accumulated by a different predator to that which accumulated packages 15, 16, 17 and 18.

Table 5.12 : Percentage representation of rodent and insectivore species in various units at Elands Bay Cave (After Avery, in prep.)

		O. unisulcatus	*A. namaquensis*	*O. saundersae*	*O. irroratus*	*S. krebsii*	*T. afra*	*G paeba*	*M. minutoides*	*M. verreauxi*	*Elephantulus sp.*	*E. rupestris*	*E. edwardii*	*M. varius*	*S. varilla*
	Range of weights→	101-156g	33-75	84-134	96-178	24g	78-113g	21-35g	6-12g	36-54g		65	50	12-16g	6.5g
	Habits→	predominantly diurnal	nocturnal	predominantly diurnal	predominantly diurnal	nocturnal	nocturnal	(probably) nocturnal	nocturnal	nocturnal		almost entirely diurnal	almost entirely diurnal	active day & night	active day & night
Pulse	Packages														
A	1-2b	20.0	37.5			12.5		2.5		2.5			7.5		2.5
A	3a-4c	33.3	31.1	3.3		2.2			1.1	2.2		5.6	3.3	1.1	
B	5a-5c	27.3	39.4	3		3		3				3	3		
C	6-7	57.4	20.6		1.5					1.5		2.9	4.4	4.4	
C	8	42.1	23.7	1.3	1.3	2.6		2.6	1.3			1.3	6.6	2.6	
C	9	32.6	29.2	1.4	0.4	2.1	0.7	2.1	0.7	0.7		6.3	2.1	2.8	
D	10a-10d	80.5	2.4				2.4			2.4		4.9			
D	11-12	83.3	2.6				1.3	1.3				1.3	1.3	1.3	
D	13	79.1	2.7	0.9			1.8						2.7		
D	14	87.5	5												
D	15-19	52.9	5.7	1.1	5.7	2.3	2.3	4.6			1.1			3.4	2.3
		C. flavescens	*C. cyanea*	*A. subspinosus*	*R. pumilio*	*D. melanotis*	*dendromus sp.*	*C. hottentotus*	*G. capensis*	*chrysochloridae*	*C. zyli*	*M. albicaudatus*	*G. ocularis*	*E. grantii*	*C. asiatica*
	Range of weights→	39g	9g	17-25g	36-53g	4-12g		125g	25-35g			75-111g	81-85g	16-30g	
	Habits→	active day & night	active day & night	active in am. dusk & night	diurnal & nocturnal	nocturnal	nocturnal	nocturnal	nocturnal	nocturnal	nocturnal	nocturnal	nocturnal	nocturnal	nocturnal
Pulse	Packages														
A	1-2b		5		4.4		2.5	2.5				2.5			2.5
A	3a-4c		6.7		9.1			2.2			1.1	1.1	1.1		
B	5a-5c		9.1		9.1			0							
C	6-7	1.5	1.5		1.5			2.9							
C	8		5.3	1.3	1.3			5.3		1.3					
C	9	1.4	3.5		8.3	0.7		2.1			0.7	0.7		0.7	
D	10a-10d		2.4		2.4			2.4							
D	11-12				3.8			1.3				2.6			
D	13	0.9	1.8		5.5			0.9	1.8			1.8			
D	14				5			2.5							
D	15-19	3.4			10.3			2.3		1.1		1.1			

Table 5.13 looks at the activity patterns of the micromammals in the different packages.

Table 5.13: The activity patterns of the micromammal species at Elands Bay Cave

Pulse	Packages	Number of species		
		nocturnal	diurnal	active day & night
A	1-2b	8	2	2
A	3a-4c	8	4	3
B	5a-5c	3	4	2
C	6-7	3	4	4
C	8	5	5	4
C	9	11	5	5
D	10a-10d	4	2	2
D	11-12	5	3	2
D	13	5	3	3
D	14	2	1	1
D	15-19	7	4	4

If the number of diurnal and nocturnal species in the various packages are compared, there is a dominance of nocturnal species in both the Holocene and Terminal Pleistocene packages. The number of species that are active day and night rather obscures any pattern that may exist as it is impossible to ascertain whether these species were caught during the day or night.

5.9 The frog bones from Elands Bay Cave

These bones appear in low frequencies in the site and some 25 frog bones, many of them broken and incomplete, may be found scattered throughout the site. No clear stratigraphic pattern may be seen in the patterning of these bones. The bones appear in numbers too small to enable any analysis to be done on breakage patterns or etching. One of the humeri comes from one of the *Xenopus* species of frog (possibly *Xenopus laevis* which occurs in the area (Passmore & Carruthers 1979)). The burrowing sand frog *Tomopterna delalandii* occurs in the area and breeds at the edge of pans, vleis, dams and lagoons (Passmore & Carruthers 1979) and the Verlorenvlei would undoubtedly have provided an attractive habitat for this species.

5.10 The lizard bones from Elands Bay Cave

The lizard bones from Elands Bay Cave appear in small numbers throughout the site in no discernible pattern. Once again, the numbers are too low to make analysis possible. It appears that the more robust bones of the lizard skeleton have survived, namely, the humerus, vertebra and the bones of the pelvis and the mandible. The few lizard bones found may represent animals that died naturally in the site. Alternatively, there may have been selection against these bones, either during the period they were in the site, or during excavation. The bones of small lizards would be extremely fragile and prone to breakage and disappearance from the archaeological record.

Chapter Six: Discussion and Conclusion

6.1 Introduction

A direct comparison of the results from the Elands Bay Cave assemblages with Andrew's (1990a) results, as regards cranial and post-cranial breakage, is not possible in that the Elands Bay Cave material has experienced various alterations during the period in which it was deposited in the site and during excavation and analysis. Andrews (pers. comm.) has said that the quantification of breakage patterns is often of little use for fossil assemblages, due to post-depositional damage. He suggested that it is more informative to compare the number of complete, as opposed to damaged, bones between the different levels of a site. This has been done for both the postcranial and cranial bones from Elands Bay Cave. Incisor digestion is the single most important criterion for identifying the predator of an assemblage. The percentage of incisors showing etching would not have been obscured by post-depositional breakage, and etching is thus a reliable tool to use in conjunction with 'completeness' ('completeness' being the number of complete as opposed to broken bones) when trying to trace the predator.

6.2 The potential predators

The owls in the Elands Bay Cave area which could have been potential accumulators of the microfaunal assemblages are the Spotted Eagle owl, Giant owl, Cape eagle owl and the Barn owl. Unfortunately Andrews' (1990a) results do not include an analysis of the pellets of the Cape eagle owl but this species usually concentrates on one of the larger prey species available, such as the dassie, molerat or hare (Steyn and Tredgold 1977). It is likely that the smaller species of micromammal would be associated with species such as the molerat, hedgehog, hare or dassie if the Cape eagle owl were the predator. The Cape eagle owl's current area of distribution does not extend as far north as Elands Bay Cave, but Elands Bay may have provided a more suitable habitat to this species in the past. The Marsh owl, Grass owl and Wood owl are all disqualified as potential predators on the basis that they roost and nest in hollows in the grass or in trees.

The Striped polecat would be the most likely mustelid responsible for the Elands Bay Cave microfaunal accumulations as it shelters in burrows and rocky outcrops. The mustelids, however, are unlikely accumulators of microfaunal bones as so few of the bones of their prey are found in the scats of these species due to the destructive manner in which they consume and digest prey (Andrews 1990a). The felids, which are even more destructive to the bones of their

prey than the mustelids, are for the same reasons, not candidates for the accumulation of the microfauna at Elands Bay Cave.

The viverrids which may have been responsible for the accumulation of the microfauna at Elands Bay Cave are the Yellow mongoose, the Small or Cape grey mongoose, the Large grey mongoose, the Water mongoose, and the Small spotted genet. The Suricate may be ruled out as it is insectivorous. The Yellow mongoose lives in large communal burrows and prefers open areas such as short grasslands or semi-desert scrub (Stuart and Stuart 1988). This species has latrines situated near the entrance of the burrow and it is unlikely that this species would have a burrow or latrine in a cave.

The Large Grey mongoose eats small rodents, reptiles, crabs, insects, amphibians and wild fruit (Stuart 1983). This species prefers areas of riparian vegetation and its current distribution area lies along the south and east coast of South Africa (Skinner and Smithers 1990). The bones of this species have, however, been recovered from Elands Bay Cave, indicating that at some period in its history the environs of Elands Bay Cave were suitable for this species. The Small grey mongoose shows a wide habitat tolerance and is found in fynbos, grassed glades, stands of keurboom, dry forest scrub and moist dry forest (Crawford *et al.* 1983). Insects form a substantial part of its diet but it also eats rats and mice and is a potential accumulator of the Elands Bay Cave microfauna. The Water mongoose usually deposits its scats on the banks of dams or rivers and is thus not likely to have deposited scats in the cave. The Small spotted genet is strictly nocturnal and rests in a hole in the ground during the day. Droppings accumulate at latrine sites which are usually in open areas, depressions or thick bush (Stuart 1977). The Small spotted genet would thus not appear to be a likely candidate unless there was a latrine area in the cave. The Large or Small grey mongoose thus appears to be the most likely of all the viverrids to be responsible for the Elands Bay Cave microfaunal accumulations.

The canids fall within category 4 or 5 in terms of Andrews (1990a) etching categories and are among the most destructive predators. Andrews (1990a) analysed the scats of various canid species but no studies were made of scats from the Black-backed jackal which is a potential predator of the microfauna at Elands Bay Cave. It is expected, however, that this jackal would fit into the general canid picture (Andrews pers. comm.). The Cape fox is associated with open country and lies in holes or dense vegetation during the day (Smithers 1983, Stuart and Stuart 1988). Given these habits, it would appear unlikely, though not impossible, that it would use Elands Bay Cave as a retreat. The Bat-eared fox is not a likely predator of the Elands Bay Cave microfauna as it lives in communal burrows, the entrances of which are marked with urine and scats (Andrews 1990a). Latrines have also been observed in open areas (Smithers 1983).

The diurnal birds of prey are not considered to be likely contenders for the microfauna at Elands Bay Cave as they do not roost in caves. To summarise, the most likely predators at Elands Bay Cave are the four owls (The Spotted and Cape eagle owls, the Giant eagle owl and the Barn owl), the polecat, the Large and Small grey mongoose and the jackal. This list leaves out one other potential predator, humans. There is evidence that people may have been responsible for the accumulation of some of the micromammal bones at Elands Bay Cave. This issue will be dealt with later on in this chapter.

6.3 Tooth loss and breakage of the cranial bones

6.3.1 Cranial breakage

The degree of cranial breakage throughout the site was generally far greater than the breakage described by Andrews (1990a) for the different predator assemblages. The degree of breakage, together with the uniformly low levels of completeness seen in both the mandibles and maxillae throughout EBC, indicates that post-depositional forces have exacerbated any predator-induced breakage and have obscured the patterning left by the predator. Package 15c, which consistently yielded results which indicated that the cranial and postcranial bones in this package are more complete than in any other, showed a relatively higher level of completeness for both maxillae and mandibles.

6.3.2 Mandibular molar loss

The uniformity and degree of percentage mandible molar loss throughout the site, like cranial breakage, indicates a loss of the original patterning. Looking at the trend shown by packages containing 15 or more mandibles, the tooth loss pattern is fairly uniform in that the packages 3a, 3b, 5c, 6, 8a, 8b, 9, 11a, 13, 14 and 15b fall into the range of 68-88% molar loss. Package 15c stands out in that it has a markedly low percentage of molar loss of 39%. This package appears to show a good degree of resolution in that the cranial bone in that package consistently appears less fragmented, relative to the other packages, for all the indices recording breakage and tooth loss. As has been mentioned above, a direct comparison of the Elands Bay Cave assemblages with Andrews' (1990a) results is not possible due to post-depositional alteration. In the case of package 15c, however, a direct comparison may be possible due to the good state of preservation of these bones. Andrews (1990a) found that the percentage of molar loss from the Barn owl mandibles was 34%, this is very close to the 39% molar loss obtained from the mandibles in package 15c.

6.3.3 Mandibular incisor loss

Mandibular incisor loss shows less uniformity throughout the site than molar loss. Looking at the results for the packages containing 15 or more mandibles, there appears to be a trend towards a lower percentage of incisor loss in the packages below 10c. Package 15c, which has the lowest percentage molar loss, shows a correspondingly low percentage of incisor loss. The lower percentage of mandibular tooth loss in the Terminal Pleistocene packages may have arisen because the mandibles were deposited in a more complete state than those in the Holocene levels. These bones were thus in a far better position to survive post-depositional stresses than the bones in the packages above, which had been deposited in a more damaged state, by category 2, 3 or 4 predators. The other bones in the Terminal Pleistocene packages (such as the humeri, femora and tibiae) also show a much higher level of completeness. This suggests that post-depositional breakage has resulted in the loss of predator-induced breakage patterns in most of the Holocene packages (where the bones were deposited in a fairly damaged state), but has been retained to some extent in the Terminal Pleistocene packages. Looking at Andrews' results, the percentage incisor loss of package 15c is intermediate between the owls and both the diurnal birds of prey and small carnivores. The intermediate nature of package 15c suggests that package 15c may represent an owl assemblage (possibly a Barn owl), the breakage and tooth loss patterns of which have been exacerbated by post-depositional damage.

Features such as hairline cracks in the enamel and dentine of incisors, manganese staining and the presence of salt crystals did not appear to be concentrated in any one particular section of the site. The bones in one area of the site looked very much like those in the others and it appeared that the influences affecting the bones after deposition had occurred more or less evenly across the site.

6.3.4 Maxillary molar loss

Maxillae appeared in lower numbers than the mandibles on the site. This is not surprising in that, due to their structure, maxillae are more prone to post-depositional destruction than mandibles. Looking at the percentage molar loss of the packages containing more than 10 maxillae, the maxillae show a uniformly high percentage of molar loss. The high percentage of molar loss is similar to that Andrews obtained for the canids, one of the most damaging categories of predator. Once again, the uniformity of results throughout the site and the high percentage of tooth loss indicates that post-depositional forces have obscured any patterning.

During analysis of the mandibles and maxillae, the micromammal teeth were prone to coming out of their sockets with handling, particularly the Vlei rats. It would thus appear reasonable to

assume that after sieving, sorting and then analysis, far fewer teeth would be found *in situ* than those initially present in the mandibles and maxillae. It is impossible to ascertain to exactly what extent this occurred but it is likely that excavation, sieving and handling of the material influenced the high percentages obtained for tooth loss and contributed to the ambiguous results obtained from these calculations.

6.3.5 The percentage of isolated molars

There is a generally very low percentage of isolated molars in the site. In fact, the majority of packages contain a percentage of isolated molars of 10% or less. Once again, the uniformity of results seen throughout the site, together with an average deficit which is generally below that of even the lowest percentage obtained by Andrews (1990a) for the various predators, indicates that selection against single molars has taken place since the mandibles and maxillae were deposited in the site. This preferential selection against loose molars may have occurred within the site and during or after excavation and most probably stems from a combination of factors. The sieves used during excavation were large enough to let molars slip through and it is also possible that the tiny molars could have been overlooked when sorting of sieved material took place.

6.3.6 Breakage of the molars and incisors

Andrews observed that for both molar and incisor breakage, *in situ* teeth were less broken than loose teeth in most of the predator assemblages. Molar breakage at EBC follows this pattern with loose molars showing more breakage than *in situ* molars in the packages containing a sizeable amount of incisors; namely packages 3a, 3b, 5c, 6, 7a, 8a, 8b, 9, 10c, 11a, 13, 14, 15b, 15c and 16c. The breakage patterns of the *in situ* incisors follow this pattern in the Terminal Pleistocene packages (once again indicating that post-depositional breakage in these packages has not totally erased the predator-induced patterns) but in the Holocene packages, *in situ* incisors are often more broken than the loose incisors. The validity of the results from the above calculations are questionable in that the high percentage of molar and incisor loss throughout the site suggests that considerable tooth loss has occurred since the micromammal bones were deposited, this loss rather invalidates the calculations of *in situ* vs isolated teeth. It is also possible that the most severely broken teeth would disappear during the archaeological procedures of sieving and sorting.

The teeth of the Namaqua rock rat and the Bush karoo rat showed a propensity to chip on the anterior laminae of the first molar, a breakage pattern not observed on the molars of other species which are structurally different. This suggests that the presence of a species whose teeth

are relatively more prone to damage than other species in an assemblage, may skew tooth breakage patterns if the number of that species varies throughout the site.

6.4 Cranial to postcranial proportions

It is difficult to know how much emphasis may be placed on the results from packages which contain relatively small samples, such as 3c, 4b, 7a, 7b and 10a, as it is uncertain as to how much sample size is affecting the results obtained. These packages show a surplus of jaws (and a surplus of distal limb bones) which may have resulted from the decapitation of prey. It is also possible that some other taphonomically related explanation may be appropriate here.

The large samples in packages 11a, 14 and 15c, which are of a more satisfactory size, also show a marked surplus of cranial material. Package 13 also contains a large sample of cranial bone, though the surplus of maxillae and mandibles is less marked in this package. The surplus of mandibles seen in packages 11a, 13, 14 and 15c is far greater than in all of Andrews' (1990a) predator assemblages, with the exception of the Hen harrier and Artic fox (See Appendix 4, Table 5). It would appear that the excess of mandibles and maxillae in packages 11a, 13, 14 and particularly 15c (which has been shown to have good resolution), indicates that there has either been preferential selection for cranial material by some sorting process, or else predator behaviour was responsible. The fact that some of the intervening packages, such as packages 15b and 16a, show the opposite scenario, with a marked surplus of postcranial bone, makes it less likely that the surplus of cranial bone in the other packages may have resulted from some sorting process. This, together with the fact that sample size is good, suggests that the surplus of cranial material in packages 11a, 13, 14 and 15c could be related to the behaviour of the predator responsible for the accumulation. The surplus of cranial bones could occur, for example, at a nest site if the prey items were being decapitated before being fed to the chicks. Another feature of packages 11a, 13, and 14 is that there was a marked difference in the numbers of maxillae, as compared to mandibles, with far higher numbers of the latter occurring in these packages. The difference between the number of mandibles and maxillae is not nearly so marked in the Holocene packages lying above package 10a. This is interesting as, given the generally greater degree of breakage and tooth loss in these packages, one would expect that the differences between the number of maxillae and mandibles would be greater there, rather than in the Terminal Pleistocene packages of the site where cranial and postcranial bones are more complete. This discrepancy in the packages which are distinguished by high levels of completeness in the cranial and especially some of the postcranial bones, suggests that trampling or some other force which was particularly destructive to the maxillae may have been at work in packages 11a, 13 and 14. It is possible, given that maxillae break down quickly when exposed to trampling, that

the lack of maxillae in 11a, 13 and 14 may be indicative of damage caused by the trampling of the owls themselves at a nest site.

6.5 Breakage patterns of the long bones and enamel etching

As has been mentioned earlier, certain bones, due to their morphology, are more prone to breakage than others and it is therefore not surprising that the femur and humerus, the bones, which together with the mandible have been found to be most resistant to damage by taphonomic forces, have been the bones which appear to have retained some of the predator-induced patterning. Figures 5.10, 5.11 and 5.12 illustrate the separation of the packages in the site into two distinct groups. - the Terminal Pleistocene packages from 11a to 16c showed high levels of completeness of the femora, humeri and tibiae together with a low percentage of etched incisors. The Holocene packages, on the other hand, contained a high percentage of etched incisors and low levels of completeness of the femora, humeri and tibiae. This differentiation between the Terminal Pleistocene and Holocene packages is particularly marked if one concentrates on the packages containing relatively large samples of 13 or more recordable incisors. This distinction between the Terminal Pleistocene and Holocene packages in the site is also reflected in the species representation of the various insectivore and Murid species found on the site. This correlation raises the question whether, if the two patterns in the site observed in the etching and breakage were predator-induced, the percentage representation of rodent and insectivore species (which shows the same general patterning) might not also be predator-induced.

The change in the general trend within the site in both breakage and the percentage of etched incisors occurs in package 10. The trends shown by sub-packages 10a, 10b, 10c and 10d are obscured by the small sample of femora, humeri and recordable incisors, especially in sub-packages 10b and 10d. In the graphs comparing incisor etching with humerus and femur completeness, sub-package 10a falls into the group formed by the Terminal Pleistocene packages. Package 10c is an outlier in that it combines a higher percentage of etched incisors with high levels of completeness in terms of the femur and humerus. This pattern could have been formed if material from different predators had become mixed.

A comparison between femur and humerus completeness (see fig. 5.10) shows the two different trends in the site, with packages 3a, 3b, 5a, 5c, 6, 7a, 8a, 8b, 9 and 19a clustering together and packages 10a, 10c, 11a, 13, 14, 15b and 16c forming another group. Some of the packages which deviate from this pattern, such as packages 2a, 2b, 3c and 4b contain small samples of femora and/or humeri and the results from these packages are therefore rather inconclusive.

Package 15c, and package 10d, show unusually high levels of completeness for the femora and humeri. The former was notable for the relatively undamaged state of the cranial material in this package as well. Package 16a shows levels of etching compatible with the Barn owl but this is based on a sample of only two incisors. The unsatisfactory sample size of this package precludes any definite decision being reached as to which of the two groups this package is most similar to. Package 19a shows a percentage of etching and level of completeness of the femur and humerus comparable to that seen in packages 2a to 9.

Packages 3d, 5c and 7a are somewhat anomalous in that they show low percentages of incisor etching, contrary to the rest of the packages around them. A comparison between breakage and etching in these packages is difficult as sample size for the femora and humeri is rather small and the breakage patterns observed may have been skewed by post-depositional damage. The low percentage of incisor etching obtained for packages 3d and 7a is from a rather unsatisfactory sample size (n=9 and n=7, respectively) and because of this the results cannot be considered decisive. Package 5c contains a larger and more satisfactory sample of incisors and femora and humeri and falls within the group formed by packages 2a to 9.

There is a corresponding increase in proximal femora and distal humeri in the packages where completeness is low and a decrease when completeness is high. This ties in with Andrew's comment that there is selection for the distal humerus and proximal tibia and femur in the assemblages formed by the most destructive predators. The distal femora and proximal humeri show no obvious patterning but were found in fairly low frequencies throughout the site. This suggests that their relative susceptibility to post-depositional damage has resulted in the removal of any predator-induced patterning. The percentage of complete, shaft, proximal and distal tibiae fluctuates over the site with no clear patterning emerging except that there is an increase in complete tibiae in the Terminal Pleistocene packages. The percentage of distal tibiae falls above 40% in most packages in the site. This is unusually high, compared to Andrews' (1990a) results from the predator assemblages and indicates that quite considerable post-depositional breakage has taken place (see Appendix 4, Table 6). Of all the long bones, the tibia yielded the highest number of shafts but these showed no clear patterning and were found throughout the site.

The breakage patterns of the ulnae in the site indicated that they have undergone considerable post-depositional damage and that little useful information could be obtained from the breakage patterns of this bone. This is illustrated by the fact that, compared to Andrews' (1990a) carnivore assemblages, ulnae completeness throughout the site is generally lower than in even the small carnivore assemblages. Surprisingly, many of the packages in the upper part of the site

contained complete ulnae though the high percentages of ulna completeness seen in packages 2a, 3c and 5a was based on poor sample sizes of one, two and four respectively. The percentages of proximal ulnae are very high as compared with Andrews owl assemblages, the diurnal birds of prey and even some of the small carnivore assemblages - The uniform distribution of the proximal ulnae in the site, as well as their high percentage of occurrence suggests that post-depositional breakage has obscured any predator-patterning. The complete lack of distal ulnae and ulnae shafts in all packages (see Table 5.9) corresponds with Andrew's (1990a) results which showed that only four of the predator assemblages contained ulnae shafts or distal ulnae. These portions of the ulna are obviously very prone to damage and destruction.

Long bone shafts were extremely rare at Elands Bay Cave and only the shafts of tibiae were found in any number on the site. Andrews (1990a) found that long bone shafts were present in very low percentages in most of the owl assemblages (the spotted eagle owl and little owl were exceptions here) and appeared in higher percentages in the small carnivore and diurnal birds of prey assemblages. The lack of long bones throughout the site suggests that post-depositional breakage has led to their removal from the archaeological record.

The variability in the etching seen in the Holocene packages was not seen as problematic as it appears to indicate that a variety of predators contributed towards the micromammal accumulations in these packages. Small sample size in some of the packages may have also been responsible for some of the variability observed. There may well have been some mixing of microfauna from the different packages and the divisions between packages in the site may have been rather indistinct. This possibility is supported by the fact that packages such as 3b, 3c and 4b show a percentage of etching which falls in between the range of etching for the various predators as given by Andrews (1990a) and packages 5b, 5c, and 6 lie just on the upper or lower borders of the ranges covered by the viverrids and the Giant eagle owl (see Fig. 6.1). The variability in these packages contrasts with the uniform pattern of incisor etching observed in the packages from 10d to 16c.

6.6 Etching of the dentine and enamel

Tooth enamel is preferentially affected by acid etching in the predators stomach and it is only in the category three or higher predators that have strong digestive systems that the dentine also becomes etched (Andrews pers. comm.). Andrews (pers. comm.) suggests that, in cases where etching of the dentine but not the enamel occurs, some other unknown factor is at work. The destruction of dentine and not the enamel has been observed by Fernandez-Jalvo and Andrews (1992) in a cave site at Atapuerca, Spain. They attributed this dentine damage to prolonged

exposure to an active alkaline environment. There is still some doubt as to the actual factor causing this dentine damage, however, as it has not been observed on any comparative material (Andrews pers. comm.).

There appears to have also been some other factor at work affecting the dentine of the incisors from Elands Bay Cave as even some of the incisors which showed very few signs of etching on the enamel in the Terminal Pleistocene packages (which may have been deposited by Barn owls and possibly, people) showed etching of the dentine. This clearly suggests that some other factor has affected the dentine as only the relatively destructive predators (from category 3 and upwards) cause etching of the dentine. This means that the presence of dentine etching cannot be used to trace the predator type throughout the site.

The Terminal Pleistocene packages (packages 11a to 16c) show the lowest percentages of enamel etching in the site and the percentage of incisors exhibiting etching on the enamel and dentine is almost equal. In the Holocene packages, the percentage of incisors showing etching on the dentine is much higher than those with etching on the enamel. This suggests that the incisors which had been subjected to more intensive digestion on the part of the predator, were more prone to whatever factor or factors were contributing to the high degree of dentine etching. It is possible that these factors exacerbated the dentine etching already caused by the predator. The dentine on the incisors in the Barn owl packages, on the other hand, had been subjected to far less etching by the predator and were thus more resistant to further damage and hence showed far lower percentages of dentine etching.

The degree of etching on the enamel was recorded but this did not prove useful for tracing predator type as it showed no correlation with the percentage of etched incisors. A comparison between the areas in which etching occurred was also not informative in that most of the etching observed occurred on the area of the tip. There were thus no distinctions in the site between the areas in which the incisors showed etching.

6.7 Identifying the predator

Andrews (1990a) noted that though breakage patterns were distorted by trampling, the percentage of etched incisors in an assemblage which had been trampled remained approximately the same. It is therefore possible to make a direct comparison between Andrews' results and the percentage of etched incisors from the Elands Bay Cave packages in terms of etching, as was not possible with breakage. This is not to say that post-depositional forces have not affected the percentages of etching on the incisors, but these patterns are unlikely to be so

distorted that they cannot be to used to indicate the category, if not the actual species, of predator involved. Figure 6.1 below shows the percentage of etching in the packages from Elands Bay Cave containing 5 or more recordable incisors, against the different category of predators as defined by the percentage of etched incisors (Andrews 1990a).

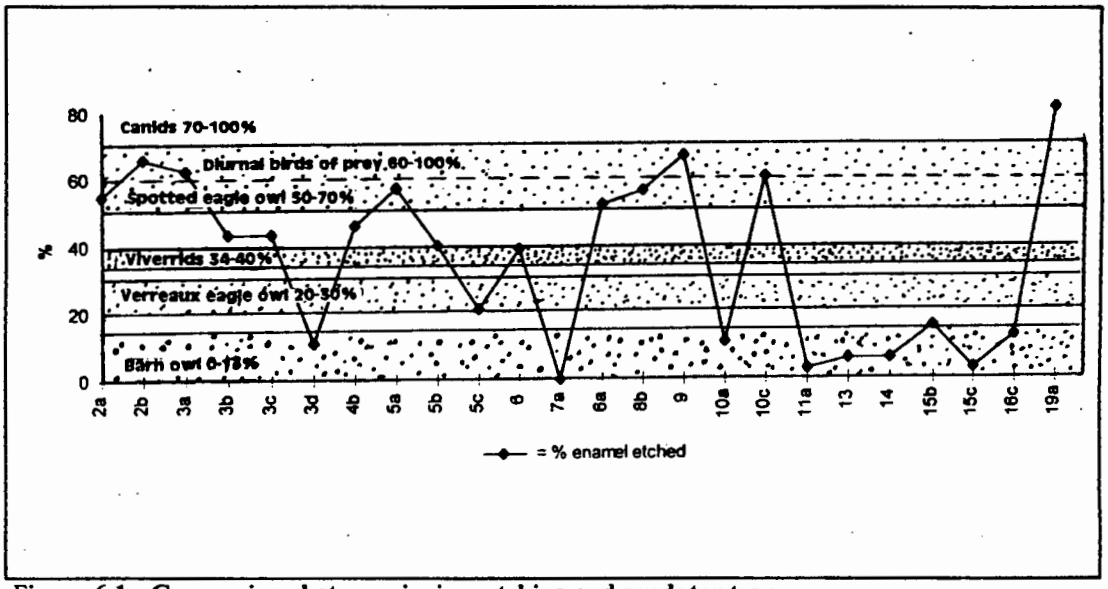

Figure 6.1: Comparison between incisor etching and predator type

Packages 11a to 16c (see Fig. 6.1 and Table 5.10) show a percentage of incisor etching compatible with a category one predator. Interpretation is greatly simplified by the fact that the only such predator occurring in the area is the Barn owl. The other option, that humans may have been responsible for the accumulation of micromammals in these packages, will also be explored below. The relatively high level of completeness of the femora and humeri found in the Terminal Pleistocene packages is compatible with the identification of the Barn owl as the predator. The high level of completeness may be attributed to the fact that the Barn owl does not cause nearly as much damage to the bones of its prey as other predator species. These bones are therefore, far less fragmented and more resistant to post-depositional damage or disappearance than the bones in the pellets or scats of other predators. The cranial bones from the Terminal Pleistocene packages are more complete than those in the other packages as is shown by the lower percentage of incisor loss from packages 10c to 16c, and the fact that the breakage patterns of the *in situ* incisors follow the pattern described by Andrews (1990a) only from package 10d and below. These results suggest that the Terminal Pleistocene deposits have retained some of their original breakage patterns and traces remain of the relatively complete condition in which the skulls were deposited. In the other packages where a more destructive predator was responsible for the accumulation of the micromammals, the cranial bones have lost all traces of their original breakage patterns. The surplus of cranial, as compared to postcranial, bone in five of the twelve packages from 10d to 16c may be an indication that decapitation of prey has taken place.

Avery (draft paper) has shown that packages 10, 11, 12, 13 and 14 show a relatively low diversity of micromammal species as compared with the other packages. This may be partly attributed to the fact that the Bush Karoo rat dominates these Terminal Pleistocene packages. This emphasis on one species as the main prey item is characteristic of the Barn owl and one of the *Otomys* species is frequently one of the main prey species taken by the Barn owl (Taylor 1994). The Bush Karoo rat is predominantly diurnal. This is interesting as the majority of the other species found in packages 10a to 14 are nocturnal.

Eight of the seventeen packages from packages 2a to 9 show incisor etching which falls within the range of the Spotted eagle owl (50 - 70%) and this owl is considered to be the most likely predator of the assemblages in these packages, though it should be remembered that there is no data available on the pellets from the Cape eagle owl. The Spotted eagle owl overlaps slightly with the diurnal birds of prey which show etching within a range of 60-100%. It is not considered very likely that diurnal birds are responsible for the Elands Bay Cave accumulations. This is supported by the fact that none of the packages show etching of over 66.6% and one would expect percentages of up to 100% if diurnal birds of prey had been responsible. Only package 19a approaches the high percentage of etching associated with canids and diurnal birds of prey. The high percentage of etching was combined with low levels of completeness of the femur and humerus which suggested that a predator other than the Barn owl had been responsible for the accumulation of package 19a. The sample size of recordable incisors, n=5, is not large enough to allow any accurate identification of the species of predator involved and it is not possible to draw any conclusions other than that the assemblage appears to have been accumulated by a predator other than a Barn owl.

Packages 2a, 2b, 3a, 5a, 8a, 8b, 9 and 10c fit in with the percentage of etching that one would expect from a Spotted eagle owl. Sample size for both the humeri and femora is too small in both packages 2a and 2b to reach any definite conclusions, but the percentage of etched incisors suggests that an eagle owl was responsible for their accumulation. Package 2a shows a level of humerus completeness (43%) on par with the levels of humerus completeness obtained by Andrews (1990a) in the Spotted eagle owl assemblage where 44% of the humeri were found to be complete. Category three predators such as the Spotted eagle owl tend to etch the tips of the incisors and this was seen in these packages. The significance of this is rather undermined by the fact that the majority of incisors in the other packages on the site show etching on the tip. Digestion of the tip of the incisor also occurs if the incisors are digested while *in situ* in the mandible or maxilla, however, and this could explain the etching on the tip of the incisors from the "Barn owl" packages.

Sub-package 10a and 10d fit into the Barn owl assemblage in terms of both etching and completeness of the limb bones (see figures 5.10, 5.11 and 5.12). Package 10d contains an unsatisfactory sample of only two recordable incisors, though the sample of femora and humeri (n=15) is more substantial. Sub-package 10c shows a level of etching compatible with an eagle owl, though the breakage patterns of the humeri and femora show a level of completeness compatible with that of the slightly etched packages. This could have resulted from some taphonomic cause or there may have been mixing of deposit between the sub-packages in package 10.

The percentage of incisors etched by the viverrids ranges from 34-40%. Packages 3b, 3c and 4b lie in between the ranges of the Spotted eagle owl and the viverrids. It is difficult to interpret the intermediate nature of these packages. It is possible that there has been mixing of the assemblages of different predators, for example, that of a Spotted eagle owl and a viverrid. Alternately, one of the more damaging categories of predator may have become mixed with Barn owl pellets, thus decreasing the average obtained for incisor etching. The fact that the Barn owl is so different to the other potential predators suggests that traces of this predator should remain (unless eradicated by post-depositional forces), in one form or another, if this predator has contributed towards an assemblage.

In terms of breakage of the long bones and etching, package 3b gives no indications that it may have been mixed with Barn owl deposits but appears to belong to some other category predator. Package 3c shows a high percentage of etching and a low level of femur completeness, but a level of completeness of humeri compatible with the Barn owl, though the latter is based on an unsatisfactory sample of two humeri. Package 3d falls into the Barn owl group in terms of femur completeness and incisor etching, but showed a low percentage of humerus completeness. Sample size is small for package 3d, n=6 for femora and humeri, and the effects of post-depositional modification unknown, so it is only possible to conclude tentatively that this package appears more Barn owl-like than anything else. Package 4b contains no femora and only 2 humeri, thus while humeri show a pattern compatible with the Barn owl packages, the sample size is really too small to reach any definite conclusions. Given the small samples in these packages, it is not possible to reach any very definite conclusions but it does appear as if packages 3c and 4b contained deposits from some predator other than the Barn owl but may have become slightly mixed with Barn owl deposits. It does not appear that post-depositional breakage has affected the breakage of the humeri and femora in packages 3c, 3d and 4b so severely that it has created an artificially broken assemblage, as packages 3c, 3d and 4b show

levels of completeness, in either the femora or humeri, compatible with that of the other Barn owl packages in the site.

It is difficult to explain the intermediate nature of the incisor etching seen in packages 3b, 3c and 4b but it would appear that mixing of deposits from different predators may have been responsible. Given the evidence that there has been mixing of deposits from different predators, it may not prove possible to identify all the predators that have contributed towards the micromammals in a package. It may be possible only to ascertain the main predator involved in the accumulation of the micromammals. Andrews (1990a) obtained the percentage of etched incisors characteristic of the viverrid predators from studies made of the scats of the White-tailed mongoose and Yellow mongoose. Another explanation as to the intermediate signature obtained from packages 3b, 3c and 4b that cannot be ruled out is that, as no study has been made of the scats of the Small and Large grey mongoose it may be that one or both of these species etch the bones of their prey to a greater degree than the other species of mongoose investigated. This is not considered very likely, however, as there was quite a considerable difference in size and in the feeding habits between the White-tailed and Yellow Mongoose, yet they showed a fairly uniform pattern of etching (Andrews 1990a).

Little can be said about the nature of package 5b, which shows a percentage of etching compatible with a viverrid, as this package contained no femora or humeri and only 5 incisors. The incisor etching of package 5c indicates that it may have been accumulated by a Giant eagle owl. The breakage of the humeri and femora also suggests that a predator other than the Barn owl has been involved in the accumulation of package 5c, though there is a possibility that post-depositional breakage may have distorted the breakage patterns. Given the evidence that some of the packages appear to contain deposits from more than one predator, the identification of the Giant eagle owl as the predator is somewhat tentatively made as the mixing of deposits from different predators could, theoretically, have resulted in the percentage of incisor etching observed. It would be expected that there would be accumulations of molerat, hare, dassie or hedgehog bones in this package if a Giant eagle owl had been responsible for its accumulation. There is, however, a minimum of bones from these species in this package (see Fig. 6.2 and Fig. 6.3, below). The relatively small size of package 5c may be an explanation for the lack of these larger species and this package may represent only a very brief visit to the cave by a Giant eagle owl.

Package 6 showed a percentage completeness of the humerus and femur compatible with a category predator other than the Barn owl and falls into the percentage of etching caused by a viverrid. Packages 5b and 6 are at the upper limits of the etching caused by viverrids. It has

been suggested above that the most likely candidates among the viverrids for the accumulation of microfauna at Elands Bay Cave are the Small and Large grey mongoose. The former is diurnal and the latter nocturnal. The packages 5b and 6, which fall into the viverrid etching category, contain slightly more diurnal species of micromammal. This doesn't rule out either species, as the Large grey mongoose has been reported as being nocturnal with some diurnal activity, and by other sources as being largely diurnal, though in the northern parts of the subregion they are definitely diurnal (Smithers 1983).

Packages 7a and 7b contain a total of 11 recordable incisors, all of which show no traces of etching. Once again sample size (n=7 and n=3, for humeri plus femora in 7a and 7b, respectively) is too small to reach any definite conclusions but the lack of etched incisors suggests a Barn owl may have been responsible for their accumulation. Another possibility is that humans were responsible for the accumulation of these micromammal remains. There is a surplus of cranial bone in these two packages, which may indicate that decapitation of prey took place as the small, bony heads of the rodents could not be eaten. It is difficult to think of circumstances which may have led to such a number of rodents dying of natural causes.

Packages 8a, 8b and 9 show a consistency in the patterning of etching and breakage in that completeness of the femora and humeri decreases as the percentage of etched incisors increases from package 8a to 8b to 9. Package 5a also shows low levels of completeness of the femora and humeri, together with a high percentage of etching which is compatible with that of an eagle owl.

Humerus completeness served to group the Terminal Pleistocene packages far more closely than femur completeness, which suggests that the femur has been more influenced by post-depositional change than has the humerus. Humerus completeness also appears to have most clearly shown up the packages which do not fall into either of the two main groupings formed by the packages when breakage patterns are compared. Inconsistencies between the patterns shown by the etching and the completeness of the femur and humerus could be attributed to taphonomic causes or sample size. Alternately, they may have resulted from the mixing of the packages from different predators or more than one species of predator may have contributed to an assemblage.

If the larger Cape eagle owl and not the Spotted eagle owl were responsible for the accumulations in packages 1 to 9, it would be expected that the bones of other, larger species of prey such as the dassie, molerat, hedgehog or hare would be found together with the micromammal bones. These species are depicted in figure 6.2 below. There are some relatively

small accumulations of hare and dassie bones in packages 3a, 8a, 9, 10c, 11a, 16a, 16c, 18a and 19b but the only dense accumulations of dassie, hare and molerat bones appear in packages 13 and 15b. The Barn owl is unlikely to have been responsible for the accumulation of such large prey species, particularly in the large numbers in which these animals occur in packages 13 and 15b. It is therefore likely that the accumulation of the larger species resulted from the activity of some other predator, in this case, most probably humans.

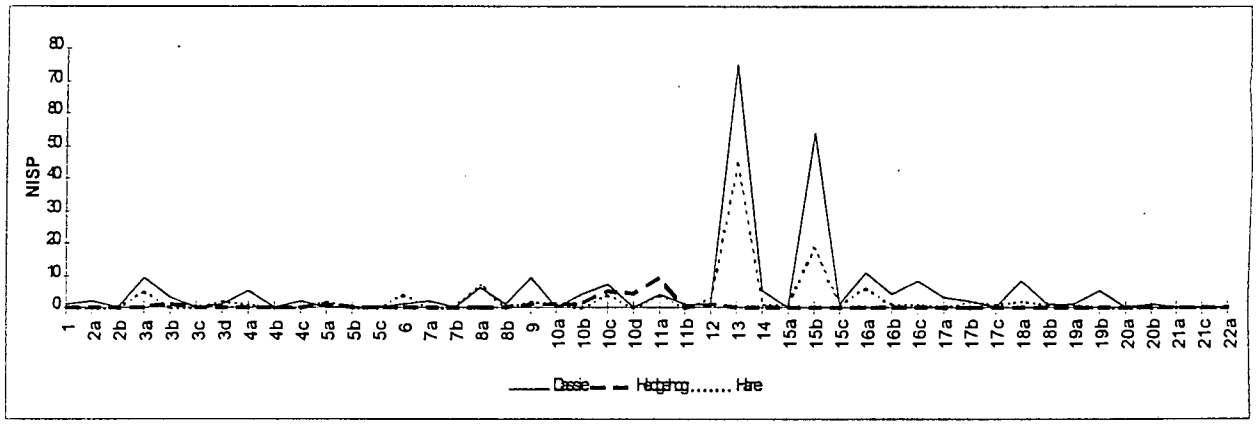

Figure: 6.2 Patterning of the dassie, hedgehog and hare bones at Elands Bay Cave.

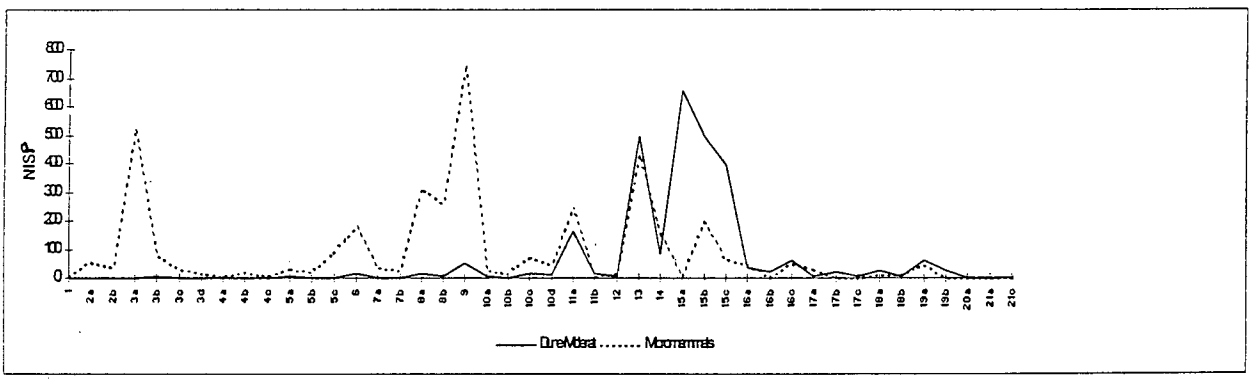

Figure 6.3: Patterning of the micromammal* and Dune molerat bones at Elands Bay Cave

*The NISP (number of individual specimens) calculated for the micromammals excludes molars and incisors as the tooth loss in some packages of the site was higher than in others ,and inclusion of teeth would have artificially increased the NISP in these packages, thus only cranial and postcranial bones were used in the calculation of NISP

The micromammal bones at Elands Bay Cave show a marked increase in density in the same packages as the dassie, hare and Dune molerat bones, that is, in package 13, with a lesser peak in package 15b. The density of hedgehog bones shows a slight increase from packages 10b to 11b, a pattern which is also seen in the micromammal and Dune molerat bones.

Klein and Cruz-Uribe (in press) have suggested that Cape eagle owls may have been responsible for the accumulation of molerat bones in packages 14 to 20. If an eagle owl were responsible for the accumulation of the molerat bones, one would expect the micromammal remains in these

packages to indicate this, particularly as the density patterns appear to suggest some association between the two. This is not the case, however, as the micromammal remains from packages 14, 15 and 16 show low levels of incisor etching which are incompatible with the identification of the predator as a Cape or Spotted eagle owl. It is unlikely that a Cape eagle owl would be exclusively eating molerats and contributing only this prey species, while a Barn owl contributed the micromammal bones, in these packages. It thus appears that Klein and Cruz-Uribe's (in press) other suggestion, that people may have been responsible for the accumulations of molerats in packages 14 to 20, is more likely.

The presence of etched incisors indicates that a Barn owl must have been responsible for at least some of the micromammal bones found in the packages from 10d to 16c. The Barn owl could have occupied the cave shortly after, or before, the human occupants. There are no obvious, potential roosting spots on the walls of the cave and it is unlikely that the Barn owl would have occupied the cave at the same time that humans were active within the cave if it meant sharing the floor space.

Klein and Cruz-Uribe (in press) note that the evidence suggests that people, and not carnivores or hyenas, accumulated the overwhelming majority of the large mammal[1] bones at Elands Bay Cave. The artefactual and faunal evidence indicates that during the period that the Terminal Pleistocene packages, packages 11 to 14 were formed, there was intensive use of the cave by human inhabitants. There is a large increase in the abundance of seal bones, in shells and in the bones of fish and shore birds in packages 13 and 15b (Parkington and Poggenpoel (in press); Klein and Cruz-Uribe (in press)). It is interesting that the micromammal, dassie, molerat and hare bones show marked increases in the same packages as the large mammals, which were accumulated by humans. This is illustrated by Figures 6.2 and 6.3.

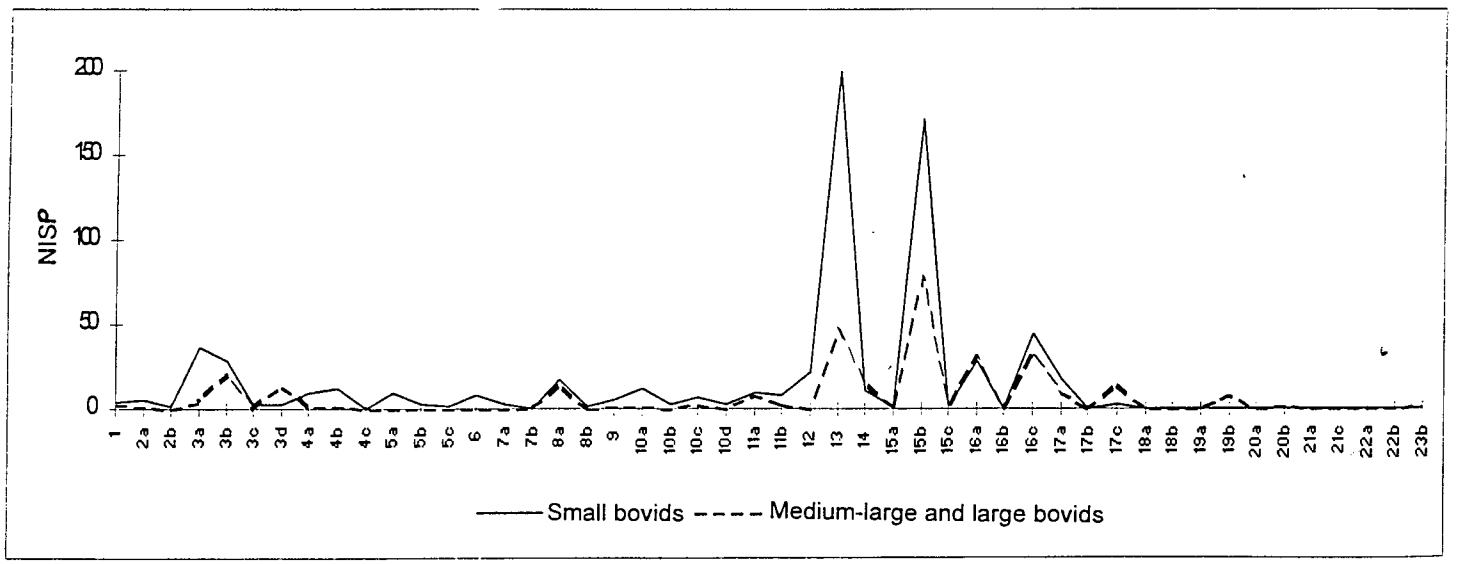

Figure 6.4: Patterning of the bovid bones at Elands Bay Cave

[1] A large mammal is taken to be any mammal species, the adult of which weighs over 0.75kg

The bovids (Fig 6.4) show marked increases in abundance in the same packages as the micromammal, dassie, molerat and hare bones in packages 13 and 15b.

Differences between the Terminal Pleistocene and Holocene packages have been observed in the breakage and etching patterns and also in the species representation of insectivore and rodent species in the site. Figures 6.2, 6.3 and 6.4 likewise show a difference in patterning between the Holocene and Terminal Pleistocene packages. The difference lies in the fact that while the micromammal bones from packages 10c to 17a show a close increase in abundance with the bovid, molerat, dassie and hare bones in the Terminal Pleistocene levels, the micromammals from the Holocene packages show fluctuations in abundance which increase independently of the other fauna on the site.

The Holocene at Elands Bay Cave is characterised by what appears to be sporadic visits to the cave (Parkington pers. comm.). The Terminal Pleistocene packages on the other hand, suggest that the cave was heavily utilized at this time. Although it has been suggested above that a Barn owl accumulated the packages from 10d to 16c, the possibility that humans may have been responsible for accumulating some of the micromammal bones in these packages cannot be totally eliminated. There is some circumstantial evidence that humans may have been responsible for the accumulation of some of the micromammal bones in the packages that have, up to this point, been called 'Barn owl' accumulations. The fact that the abundance of micromammal remains increases in packages 11a, 13 and 15b, along with the dassie, hedgehog, hare, molerat bones, and all the other faunal accumulations for which humans were responsible, suggests that there may be some association between at least some of the micromammal accumulations in these packages and the other faunal and artefactual remains. The other alternative is obviously that another predator, such as the Barn owl, was responsible for the accumulation of these packages. If the Barn owl were the predator, however, it is hard to explain away the marked correspondence of the fluctuations of micromammal bones with all the other faunal material which was accumulated by people in the Terminal Pleistocene packages, packages 11a, 13 and 15b. It would mean that Barn owls would have to have been occupying the cave shortly after or even during the time that it was occupied by people. If this were the case, it is strange that large accumulations of micromammals did not build up in any of the periods when there were hiatuses in the occupation of the cave by people.

The most common species in packages 10 to 15 is the Bush Karoo rat. This species is fairly large and weighs from 101-156g and would, therefore, be a potentially attractive source of protein to humans. The fact that there is a surplus of mandibles and maxillae in packages 11a, 13, 14 and 15c, a surplus which is far greater than in all of Andrews' (1990a) predator

assemblages, provides some more evidence that humans may have been responsible for the accumulation of micromammals in these packages. The surplus of cranial material could represent decapitation of the inedible skulls - it may be significant that packages 7a and 7b, which have also been cited as possibly being accumulated by humans, also show a surplus of cranial bones. The femora and humeri in these sub-packages show relatively high levels of completeness and this could be attributed to the discard of the long bones during preparation or consumption as the long bones would be too hard to eat. As was mentioned earlier, it is not likely that the deposition of coprolites led to the accumulation of microfauna at Elands Bay Cave.

6.8 Conclusion

It has been noted by Cruz-Uribe (1988) that the diversity and richness of an archaeological assemblage is influenced by both predator behaviour and environment. Micromammal studies in South Africa have tended to ignore the influence that the predator may have on the diversity and richness of a fossil micromammal assemblage and have interpreted changes over time in the latter in terms of changes in palaeoclimate and palaeoenvironment (Avery 1981, 1982, 1987, 1990, 1991, 1992). This occurred because analyses were based on the assumption that the predator was a Barn owl , the 'perfect predator' in terms of both selection and preservation of prey. Once the assumption of the Barn owl as the predator of a fossil assemblage was made, the results from analyses measuring aspects such as changes in mean size of individuals and diversity of fossil micromammal assemblages were interpreted in terms of changes in climate and environment (Avery 1981, 1982, 1987, 1990, 1991, 1992). The assumption that the predator was a Barn owl was not based on any microscopic investigation such as was done in this thesis on the incisors of the micromammals from Elands Bay Cave. This methodology thus led to the omission of the numerous variables that could be introduced if a predator other than the Barn owl had been involved in the accumulation of the archaeological micromammal assemblages. In many cases, in sites such as Boomplaas (Deacon 1995) or Steenbokfontein (Jerardino pers. comm.), the micromammal remains have been deposited in dense lenses, the nature of which indicates that they were in all probability deposited by an owl, and the Barn owl is a likely candidate. In other cases, however, it is possible that the assumption that the predator was a Barn owl may have erroneously led, either to the exclusion of other potential predators, or there may have been mixing of assemblages from different species of predator (Avery 1981, 1982, 1987, 1990, 1992). This would have obvious implications for the palaeoclimatic or environmental changes deduced from such results. Sections 2.4.1 to 2.4.4 deal with the many variables that may influence the size and species composition of the micromammal sample appearing in scats or pellets. These sections clearly illustrate the way in which the different species of predator, hunting in the same area, could present very different pictures of the micromammal population.

The results from Elands Bay Cave have shown that more than one predator was involved in the accumulation of the micromammals and the Barn owl was found to have been active in only some of the packages in the site. The Spotted eagle owl, a viverrid and possibly a Giant eagle owl were identified as the predators possibly responsible for the accumulation of micromammals in packages 1 to 9. There is some evidence that people may have been responsible for the accumulation of some of the micromammal bones in packages 10 to 16c. People have been very much ignored as potential predators of microfauna on archaeological sites. The evidence for people as predators of the micromammal bones in packages 10 to 16c should not be discounted and should perhaps be remembered in the future analysis of archaeological sites. It is difficult to predict what patterns would be observed in micromammal assemblages if they had been accumulated by people. If we do not look for them, however, we will not find them.

Avery (.in prep .) has shown that the percentage representation of rodent and insectivore species in packages 15 to 19, (sub-packages 15a, 15b, 15c, 16a, 16b, 16c, 17a, 17b, 17c, 18a, 18b, 19a and 19b were added together to form samples large enough for analysis), was very different to both the other Terminal Pleistocene and the Holocene packages (see Table 5.12). All the packages from 15a to 17a show a pattern of breakage and incisor etching which suggests that these assemblages were formed by the Barn owl (or possibly people). Package 19a, however, shows etching and breakage patterns compatible with a higher category predator than the Barn owl. Sample size is not large for package 19a, there are only five recordable incisors and ten mandibles and maxillae, but the fact that this package has been found to come from a predator other than the Barn owl means that it may have influenced the overall percentage composition of rodent and insectivore species in packages 15 to 19. This could explain why these packages appear different to the other Terminal Pleistocene packages. Caution should therefore be exercised in attributing the variations seen in this package solely to palaeoenvironmental change. These results clearly illustrate the danger of adding small samples together for the purposes of analysis without making sure that they came from the same predator.

Sample size may also prove very relevant in terms of interpretation of the Elands Bay assemblages. The small sized samples in some of the packages may have been accumulated over relatively short periods of time. The contents of these assemblages may therefore have been influenced by short-term fluctuations in the micromammal community or may be skewed through predator-induced behaviour, thus representing pulses in time rather than long-term averages.

The adding together of small samples in order to form samples large enough for analysis is a common practice in the analysis of archaeological faunal material. The results from Elands Bay

Cave suggest, however, that the adding together of small samples, without adequate investigation of the nature of the relevant samples, may result in the mixing of assemblages which were deposited by different predators. Avery added together sub-packages 5a, 5b and 5c and 10a, 10b, 10c and 10d. for the purposes of analysis of packages 5 and 10. Table 5.10 and Fig. 5.9 (which record the etching of the incisors from Elands Bay cave) clearly illustrate that there is much variability in the etching in these sub-packages. This variability in etching suggests that more than one species of predator was involved in the accumulation of micromammals. Several other packages and sub-packages were also merged to form larger samples for analysis. This merging of sub-packages and packages was, in the light of the information obtained from the incisor etching, inappropriate. Micromammal assemblages that have been deposited by a mixture of predators can not safely be used to trace changes in palaeoenvironment unless the variables introduced by these predators are taken into account.

As mentioned earlier in this chapter, two different patterns or trends emerged from the study of the patterns of breakage and incisor etching in the site. This differentiation between the two groups of packages in the site may also be seen in the percentage representation of rodent and insectivore species (see Table 5.12) in that there is a great degree of similarity in the frequency and type of species found in packages 2a to 9 and also between the packages from 10a to 14. The fact that the work done by Avery (in prep .) showed the same general trends as the breakage and etching patterns, which were predator-induced, suggests that the patterns observed by Avery (which were interpreted as representing changes in environment) were also influenced by predator behaviour.

The assumption that short-term fluctuations may be safely ignored (Avery 1982, 1990) during the analysis of fossil micromammal assemblages can be questioned in the light of the evidence that factors other than climatic or environmental change, such as fire, may have long-term effects on the micromammal community living in an area (see section 2.5.1). This, in turn, ties in with the affect that the period of deposition of an archaeological assemblage could have on the micromammal population represented. This question is very difficult, if not impossible to resolve, but if the time period being dealt with is relatively short, the accumulation could well represent a transitory glimpse of a rodent population. This population could have been influenced by a number of variables of which the analyst is unaware. There is therefore a chance that one is analysing not only long-term trends, but also assemblages which accumulated quickly and may therefore present skewed or incomplete pictures of the micromammal population at the time that they were accumulated. The species composition of an assemblage accumulated by a predator over a relatively short period may have been influenced by seasonal

change, a natural disaster such as a fire or a drought, or fluctuations in the rodent community itself. It may therefore not be safe to assume that short-term trends may always be ignored.

The results of this project have certain implications as regards the methodology that should be used when using micromammals for palaeoenvironmental research. Identifying the predator of a micromammal assemblage (using the guidelines developed by Andrews 1990a, 1990b, 1992) prior to palaeoenvironmental analysis greatly increases the analysts understanding of the factors affecting the deposition and nature of the assemblage. Ascertaining the predator provides information on the condition of the bones and teeth when they were deposited in pellets and scats. This is important as the condition of the bones would have affected the ability of the bones to withstand taphonomic stresses, and hence their survival, prior to excavation and recovery. Different species of predators may hunt in different environments or, even if they hunt in the same area, may select different prey species. Once the predator or predators of an archaeological assemblage have been identified, the many variables which may have been introduced by that predator in terms of prey selection may then be taken into account. In this way, changes in the species representation of micromammal assemblages which were caused by changes in predator will not be incorrectly attributed to environmental change.

The intention of this thesis was to use taphonomy to complement the existing studies made of the micromammal components of archaeological sites in South Africa and, at the same time, to test the traditional supposition that the Barn owl was the predator. The results of this study indicate that taphonomy may aid in ascertaining not only the predator of the micromammals, but may also help in eliminating potential predators of some of the other fauna on the site as well. Taphonomy can provide vital information both on how the microfauna became associated with the site, and on the various physical and chemical forces which have affected the bones subsequent to deposition and excavation. This information is vital for the correct intepretation of archaeological microfaunal assemblages, especially if these assemblages are to be used to trace palaeoenvironmental change. Taphonomy enables the analyst to have a more holistic approach to the interpretation of archaeological micromammal assemblages.

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Appendix 1

The species of micromammals found in Elands Bay Cave (after Avery in press)

Elephantulus rupestris	Smith's rock elephant shrew
Elephantulus edwardii	Cape rock elephant shrew
Myosorex varius	Forest shrew
Crocidura flavescens	Greater musk shrew
Crocidura cyanea	Reddish-grey musk shrew
Suncus varilla	Lesser dwarf shrew
Cryptochloris zyli	Van Zyl's golden mole
Chrysochloris asiatica	Cape golden mole
Eremitalpa granti	Grant's golden mole
Cryptomys hottentotus	Common molerat
Georychus capensis	Cape molerat
Otomys saundersiae	Saunders's vlei rat
Otomys irroratus	Vlei rat
Otomys unisulcatus	Bush karoo rat
Gerbillurus paeba	Hairy footed gerbil
Tatera afra	Cape gerbil
Mystromys albicaudatus	White-tailed rat
Dendromus sp.	Climbing mouse
Dendromus melanotis	Grey climbing mouse
Steatomys krebsii	Krebs's fat mouse
Acomys subspinosus	Cape spiny mouse
Rhabdomys pumilio	Striped mouse
Mus minutoides	Pygmy mouse
Myomyscus verreauxi	Verreaux's mouse
Aethomys namaquensis	Namaqua rock rat
Graphiurus ocularis	Spectacled dormouse

Notes on some of the most common rodent species found in Elands Bay Cave

Cryptomus hottentotus - Common molerat
This species lives in small colonies and are particularly active in extending their burrows after rain (Smithers 1983). They have a poor sense of smell and bad eyesight but are extremely sensitive to vibrations. They move to investigate any damage or opening of the entrance to their burrow and this makes them easy to trap as a trap inserted into the burrow will catch them when they come to investigate (Smithers 1983).
Range of weights (De Graaff 1981); Males: 112-145g
Females: 98-153g

Otomys saundersae - Saunders' vlei rat
Very little is known about this species. It has been reported as being diurnal in habit (Stuart and Stuart 1992). This species is found in mountainous habitats and is also found in belts of dry rushes in heath country (De Graaff 1981).
Range of weights (De Graaff 1981); Males: 100-134g
Females: 84-107g

Otomys irroratus - Vlei rat
De Graaff (1981) notes that this species prefers grass-covered ground, close to streams and marshes, though this is not a hard and fast rule. Stuart and Stuart (1992) note that this species can also be found in drier habitats, such as grassy hillsides. This species forms tunnels and runways through the bush and is strongly associated with certain speciesof plants. It moves mainly above the ground. This species breeds throughout the year. Predators mentioned by De Graaff (1981) are the barn, marsh and grass owls. Other predators listed are the mongoose, African Polecat, Genet, Serval, Wild cat, Jackal, Fox (species unrecorded). The Black-shouldered kite and the Honey Badger were also mentioned. This species is terrestrial, but near water may be amphibious as well. The vlei rat is diurnal, but some nocturnal activity has been recorded. De Graaff (1981) notes that the species is semi-gregarious (they tend towards adult isolation) and where it is found, it usually is plentiful.
Range of weights (De Graaff 1981); Males: 100-173g Females: 96-178g.
Smithers (1983) notes the weights at males:59-178 and females at 71-238g.

Otomys unisulcatus - Bush karoo rat
This species prefers drier habitats and tends to avoid damp areas. De Graaff (1981) writes that it is found in shrub and Karoo-like vegetation, usually interspersed with rocks and stones. This species builds large, communal nests and is diurnal. Predators and reproduction are unknown (De Graaff 1981).
Range of weights; Males: 125-156g
Females: 101-135g.

Gerbillurus paeba - Hairy footed gerbil
This species likes sandy soil, sandy alluvium with a scrub, grass or light woodland cover and are nocturnal and terrestrial (Smithers 1983). These gerbils show no sexual dimorphism (De Graaff 1981).
Weight for both sexes: 21-35g (De Graaff 1981).

Tatera afra - Cape gerbil
De Graaff (1981) gives the range of weights of the males of this species as ranging from 84-113g, for females the range was 78-107g. This species prefers loose, sandy soil and lives in underground burrows. The burrows made by this species is a maze of passages and they burrow, blocking up the tunnel with sand after them, when pursued. They are nocturnal and live in loosely-knit colonies (Stuart and Stuart 1992) that this gerbil moves in short, local migration patterns, however, they do not have a back and forth migration pattern. Their main enemy appears to be snakes (De Graaff 1981).
Range of weights (De Graaff 1981); Males: 84-113g
Females:78-107

***Mystromys albicaudatus* - White-tailed mouse**
This species is nocturnal and terrestrial and live in burrows deserted by other species or in cracks in the soil (Smithers 1983). This species is also called the White-tailed rat and also has been called by its colloquial name, the South African hamster. In the text of this thesis it may be called a rat or mouse, depending on the sources being qouted from. De Graaff (1981) notes that its presence in an owl pellet indicated its occurrence into the Vryburg shrub /Bushveld.
Range of weights (De Graaff 1981); Males: 78-111g
Females: 75-81g.

Steatomy krebsii - Krebs fat mouse
This species is nocturnal and terrestrial. This species prefers a sandy substrate and are found in dry, sandy grassland and sandy alluvim. This mouse may be solitary or may occur in pairs.
Weight: 24.0g

Rhabdomys pumilio - Striped field mouse
This species is predominantly diurnal with peaks of activity from 05h00-06h30 and from 14h30-17h30 (Smithers 1983). It lives in a wide variety of habitats but needs some grass cover. They excavate burrows and make their nests underground (Smithers 1983). Range of weights (De Graaff 1981); Males: 41-53g
Females: 36-51g

Mus minutoides - Pygmy mouse
This species has a wide habitat tolerance and are found in the Cape Macchia Zone, savanna grassland and woodland areas and in areas with a mean average rainfall from about 100mm in the southwest to about 1000mm in the northeast. This mouse is nocturnal and terrestrial and are not a communal species (Smithers 1983). They live in shallow burrows or shelter under fallen logs, piles of debris, boulders or old termite mounds.
Range of weights; Males:2.0-12.0g
Females: 3.0-10g (Smithers 1983). De Graaff gives a range of weight of 6-12g for this species.

Myomyscus verreauxi - Verreaux's mouse
This mouse is nocturnal and terrestrial and are found in scrub on grassy hillsides and on forest margins, particularly in riverine forest (Smithers 1981). They are found in vleis with grass cover, damp meadows and in the Knysna area.
Range of weights (Smithers 1983); Males: 41.0-54.0g
Females: 36.0-42.0g

Aethomys namaquensis - Namaqua rock mouse
This species has a wide geographical distribution which reflects its wide habitat tolerance (De Graaff 1981). This species lives in rock crevices and outcrops or in piles of stones in the veld. These rodents live in communal nests and are partly aboreal, though predominantly terrestrial. They are generally nocturnal. With regard to predators, De Graaff (1981) notes that very little is known and suggests the mongoose and snake as likely.
Range of weights: Males: 38-75g
Females: 33-57g (De Graaff 1981).
Smithers (1983), however, gives the weights as less; 33-57.9g males and 35-54.4g females.

Appendix 2 Below is the list of units, packages and pulses in Elands Bay Cave.

ACRONYM	UNIT NAME	NUMBER OF BUCKETS	PULSE	PACKAGE	AGE
AMIN	AMIN	68.75	A	1	300
KEKA	KENNETH KAUNDA	41.75	A	1	300
KENY	KENYATTA	6	A	1	300
POIS	POISON	3.5	A	1	300
AWTW	ASH WITH TWIGS	18.25	A	2A	330
CASA	CASABLANCA	3.5	A	2A	320
FNLA	FNLA	2.5	A	2A	320
HAMM	HAMMOND-TOOKE	3.5	A	2A	320
IANS	IAN SMITH	75.5	A	2A	320
MONI	MONICA WILSON	1.5	A	2A	320
MUZO	MUZOREWA	1	A	2A	320
NKOM	NKOMO	29	A	2A	320
SELA	HAILE SELASSIE	4	A	2A	320
SITH	SITHOLE	18.25	A	2A	320
STWI	SURFACE WITH TWIGS	50.5	A	2A	330
TODD	GARFIELD TODD	1	A	2A	320
TWIG	TWIG LENS I	4.5	A	2A	330
WELE	WELENSKY	3	A	2A	320
BUMO	BURNT MOBUTU	1	A	2B	550
CNET	CRUST AT BASE OF NETO	1	A	2B	550
HNET	HEARTH AT BASE OF NETO	1	A	2B	550
HMRS	HEARTH IN MRS. BALLS	1	A	2B	500
ROBE	HOLDEN ROBERTO	8	A	2B	550
MOBU	MOBUTU	13.5	A	2B	550
MRSB	MRS. BALLS	17	A	2B	500
NETO	NETO	8	A	2B	550
SAMO	SAMORA MACHEL	4	A	2B	550
SENG	SENGHOR	3.5	A	2B	550
BARN*	BARNACLES FROM REAR OF CAVE	2.5	A	3A	950
BEDP*	BEDDING PATCH (NOT DOLLY)	34	A	3A	900
DOLL*	DOLLY	66	A	3A	950
DOL2*	DOLLY SPIT II	36.25	A	3A	950
DOSU*	SURFACE OF DOLLY	32	A	3A	950
SDUN*	SURFACE AND DUNG	16.75	A	3A	950
SURF*	SURFACE	11.3	A	3A	950
CCLA*	CASSIUS CLAY	36.5	A	3B	1000
GEOB*	GEORGE BEST	71.25	A	3B	1000
ALEN*	ASH LENS	31.5	A	3C	1100
ALMJ*	ASH LENS ABOVE MICK JAGGER	4	A	3C	1150
BING*	BING CROSBY	16.35	A	3C	1100
BHOP*	BOB HOPE	5	A	3C	1150
BRST*	BRIAN STATHAM	32.25	A	3C	1250
		89.1			
ELPR*	ELVIS PRESLEY	29.625	A	3D	1350
JECH*	JESUS CHRIST	162.5	A	3D	1350
LIAP*	LENS I ABOVE PIT	25	A	3D	1300
TCHA*	TCHAIKOVSKY	19.5	A	3D	1350
ABRU	ANDRE BRUYNS	7	A	4A	1350

ACRONYM	UNIT NAME	NUMBER OF BUCKETS	PULSE	PACKAGE	AGE
BUTH	BUTHELEZI	94	A	4B	1400
TOMM	TOP OF MAJI MAJI	6	A	4B	1400
MATZ	MATANZIMA	3	A	4C	700
SMIT	SMIT	19.5	A	4C	650
POTA	POTATO	41.875	A	4C	650
POTS	SALTY POTATO	48.5	A	4C	700
POTG	GREY POTATO	5.5	A	4C	650
GALI	GALILEO	1	A	4C	700
COPE	COPERNICUS	1.5	A	4C	700
KEPL	KEPLER	3.5	A	4C	700
PIEC	PIT IN EL CHAMA	2	A	4C	750
ELCH	EL CHAMA	14	A	4C	750
BAEC	BASE OF EL CHAMA	2.5	A	4C	750
RAYI*	RAY INSKEEP	19.5	B	5A	1550
MIJA*	MICK JAGGER	55	B	5A	1550
FRRI*	FIRE BELOW RRI	1.5	B	5A	1550
DOLA*	DOROTHY LAMOUR	81.1	B	5A	1550
CKEE*	C.KEELER	33.25	B	5A	1550
DAKA*	D.KAYE	3	B	5A	1550
ALAG*	ASH LENS ABOVE GERMAINE GREE	4.5	B	5A	1550
MRSN	MRS NKRUMAH	19.5	B	5B	1650
GADD	GADDAFFI	31.5	B	5B	1650
HEAR	HEARTH I/II/GADDAFFI	1	B	5B	1650
GEGR*	G.GREER	13	B	5C	1750
EVGO*	EVONNE GOOLAGONG	7.85	B	5C	1750
APAT*	ALAN PATON	2.5	B	5C	1750
LARM*	LOUIS ARMSTRONG	62.5	B	5C	2200
		85.85			
GSFB*	GREYISH SOIL WITH FRAG. BEDDIN	24	C	6	3600
RING*	RINGO STARR	20	C	6	3550
NENY	NEO-NYERERE	9.25	C	6	3400
NYER	NYERERE	57.75	C	6	3400
ACHE	ACHEBE	4	C	7A	3300
MAJI	MAJI MAJI	22	C	7A	3300
MANT	MANTAS	3	C	7A	3300
MASI	MARGARET SINGANA	3	C	7A	3300
RETS	RETHA SMIT	20.5	C	7A	3300
BOMM	BOTTOM OF MAJI MAJI	10	C	7B	4150
DIDO	DIDO	18	C	7B	4150
RADS	RADIE SMIT	10.5	C	7B	4150
JOFR*	JOE FRAZIER	174.875	C	8A	3750
JFR1*	JOE FRAZIER I	68	C	8A	3750
JFR2*	JOE FRAZIER II	46.25	C	8A	3750
BSJF*	BROWN SOIL IN JOE FRAZIER	13.25	C	8A	3750
LMLE*	LOUIS AND MARY LEAKEY		C	8A	3850
LSBL*	LSB LEAKEY	23.5	C	8A	3850
MDLE*	MARY D. LEAKEY	23.75	C	8A	3850
BJFR	BURIAL BELOW JOFR	2.25	C	8A	8000

ACRONYM	UNIT NAME	NUMBER OF BUCKETS	PULSE	PACKAGE	AGE
CHOW	CHOWGLAY	12	C	8A	3750
SWGO	SEWGOLUM	3	C	8A	3750
TOPD*	TOP OF DOLLAR BRAND	13.5	C	8B	3800
DBRA*	DOLLAR BRAND	31	C	8B	3800
HIDB*	HEARTH IN DOLLAR BRAND	0.5	C	8B	3800
OBOT	OBOTE	12	C	8B	3800
PASO	PARA-SOYINKA	0.5	C	8B	3800
SOYI	SOYINKA	16	C	8B	3800
ALBK	ASH LENS IN BASE OF KARATE	2.5	C	9	4200
BARH	BASE OF RHINO	5.125	C	9	3950
BNEF	BOTTOM OF NEFERTITI	1.75	C	9	4300
BRRH	BROWN RHINO	2.75	C	9	3950
DAAN	DINGAAN	19.75	C	9	4300
ELEP	ELEPHANT	14	C	9	3900
HIPO	HIPPO	3	C	9	3900
JUDO	JUDO	15	C	9	4200
KARA	KARATE	19	C	9	4200
KUFO	KUNG FOOD	9	C	9	4200
NEFE	NEFERTITI	61.5	C	9	4300
NIMO	NICO MOUTON	10	C	9	4250
PGRO	P.GROENEWALD	4.5	C	9	4250
PSHA	PRE-SHAKA	3	C	9	4350
RHIN	RHINO	76.75	C	9	3900
SASO	SANS SOUCI	10	C	9	3900
SAVI	SAVIMBI	7.5	C	9	4350
SEKH	SERETSE KHAMA	1.5	C	9	4350
SHA2*	SHAKA II	7.5	C	9	4350
SHAK*	SHAKA	165.5	C	9	4350
TUTA	TUTANKHAMUN	23.5	C	9	4300
UITT	UIT EN TUIS	4.75	C	9	4350
WAYA*	DINGISWAYO A	20.5	C	9	4300
WAYB*	DINGISWAYO B	5.125	C	9	4300
BERO*	BEDDING ROBESON	33.5	D	10A	8400
BER1*	BEDDING ROBESON I	4	D	10A	8400
BER2*	BEDDING ROBESON II	2.5	D	10A	8400
BMAR	BURNT MAROON ROBESON	7	D	10A	8100
BURH	BURNT RHINO	1.5	D	10A	8100
MARO	MAROON ROBESON	60.5	D	10A	8100
NERO	NEW ROBESON	19.5	D	10A	8600
OLIV	OLIVE SCHREINER	5.25	D	10A	8000
SPAS	SPASSKY	2.25	D	10A	8000
WINK	WINNIE KRIEL	15.5	D	10A	8000
BLIR	BELOW LIMPET ROBESON	1	D	10B	8850
BURO	BURNT ROBESON	88	D	10B	8850
PWBO	PW BOTHA	45.25	D	10B	9000
WIRO	WHITE ROBESON	16.5	D	10B	8600
BOBM	BOBBY MOORE	1.5	D	10C	8500
EUSE	EUSEBIO	7.25	D	10C	8500
JVOR*	JOHN VORSTER		D	10C	8850
PKER*	PAUL KERES		D	10C	8050
PARO*	PAUL ROBESON	28.5	D	10C	8300
PAR1*	PAUL ROBESON I	22.5	D	10C	8300

ACRONYM	UNIT NAME	NUMBER OF BUCKETS	PULSE	PACKAGE	AGE
PELE*	PELE	132.25	D	10C	8500
WEBB	HARRY WEBB	9.5	D	10C	8500
ALAB	ASH LENS ABOVE BRUSH	3.5	D	10D	8700
BETT	BETTY	5.5	D	10D	8750
BRUS	BRUSH	19.75	D	10D	8750
MAGG	MAGGIE	4	D	10D	8750
SPAD	SPADE	9	D	10D	8750
ALSO	ASH LENS ABOVE SOIL	2	D	11A	8900
BSAN	BROWN SOIL ABOVE NEPTUNE	9	D	11A	8900
BURR	BURROW	2	D	11A	8900
HSOI	HEARTH IN SOIL	2.5	D	11A	8900
HOLE*	HOLE	18.5	D	11A	8900
HOCO*	HOLE CONTENT	14	D	11A	8900
LITH*	LENSE IN TOP OF HOLE	1	D	11A	8900
MUSO	MUSSEL SOIL	7.25	D	11A	8900
SLOP	SLOPE CLEANINGS	39.25	D	11A	8900
SOIL	SOIL	74.5	D	11A	8900
SOSU	SOIL SURFACE	7.5	D	11A	8900
SOME	SOMETHING ELSE	14.25	D	11A	8900
BOGA	BASE OF GREY ASHES	5	D	11B	8900
CHAU	CHAUVINISM	15.5	D	11B	8900
AGB1	GREY ASH IN GBS 1	5	D	11B	8900
NIKO	NIKON	2	D	11B	8900
ALGN	ASH LENS ABOVE GNOME	8.5	D	12	9500
ALZC	ASH LENS ABOVE ZOSTERA CAP	3	D	12	9500
ASHL	ASH LENS	8.25	D	12	9500
ELFO	ELF	9.5	D	12	9500
TOPG*	TOP OF GNOME	1	D	12	9500
GNOM*	GNOME	35	D	12	9500
GNO2*	GNOME II	1	D	12	9500
HOBI	HOBBIT	10.25	D	12	9500
ORCO	ORC	3	D	12	9500
AAZC	ASH LENS ADJACENT TO ZOST CAP	1	D	13	9200
APOL	APOLLO		D	13	9650
ATLA	ATLANTIS	2	D	13	9650
BENE	BELOW NEPTUNE	37.75	D	13	9800
BEPW	BELOW P.W. BOTHA	2	D	13	9200
BLEN	BLACK LENSE	5.5	D	13	9400
BRNE	BROWN NEPTUNE	16	D	13	9450
BSBP*	BROWN SOIL BELOW PELE	183.5	D	13	9550
BSJH*	BROWN SOIL BELOW JIMI HENDRIX		D	13	9550
BSP1*	BSBP I	16.5	D	13	9550
BSP2*	BSBP II	12.25	D	13	9600
JIHE*	JIMI HENDRIX		D	13	9550
BURN	BURNAPENA	38	D	13	9400
DECE	D.C.	4.5	D	13	9800
DUCA	DUCATI	2	D	13	9200
FAKE	FAKE BURNAPENA	3.75	D	13	9400
GONE	GONE	14	D	13	9400
GREL	GREENISH LENSE	1	D	13	9450
HONE	HOLE IN NEPTUNE	0.5	D	13	9650
JAJO	JANIS JOPLIN	15.75	D	13	

ACRONYM	UNIT NAME	NUMBER OF BUCKETS	PULSE	PACKAGE	AGE
LIMP	LIMPOPO	15.66	D	13	9800
LOBO	LOUIS BOTHA	6	D	13	9200
NEPT	NEPTUNE	58.25	D	13	9650
NUIS	NUISANCE	1.5	D	13	9450
PSEI	POSEIDON	1.5	D	13	9400
SOLE	SONNY LEON	15.3	D	13	9200
YASM	YASMIN	13	D	13	9400
ZAMB	ZAMBEZI	0.75	D	13	9800
ZOST	ZOSTERA CAPPING	45.25	D	13	9200
ALAC	ASH LENS ABOVE CRAB	11.25	D	14	9950
ALBL	ASH LENS BELOW LOBSTER	10	D	14	10050
ALBC	ASH LENS IN BASE OF CRAY	16.25	D	14	10050
BACR	BASE OF CRAYFISH	4	D	14	10050
CRAB	CRAB	12.25	D	14	9950
CRAY	CRAYFISH	27.5	D	14	10000
FLIP	FLIPPER	6.5	D	14	10050
GRLC	GREEN LENS ABOVE CRAY	4.5	D	14	9950
GLAC	GREEN LENS ADJACENT TO CRAY	2	D	14	10000
LOBS	LOBSTER	14.75	D	14	10050
BEST	BELOW STONES	1	D	15A	10500
FRTU	FRIAR TUCK	5	D	15A	10500
MAID	MAID MARION	6	D	15A	10500
ROHO	ROBIN HOOD	9	D	15A	10500
BSAS	BOTTOM OF SANS SOUCI	1.5	D	15A	10500
ASHE	ASHES	57.75	D	15B	10600
BAAD	BAADE	32.25	D	15B	10450
HBDU	BOTT.OF DUST/HEARTH BELOW DU	7	D	15B	10550
BUBB	BUBBLES	18.75	D	15B	10450
BS01	BURNT SOIL I	7.75	D	15B	10650
BS02	BURNT SOIL II	7.75	D	15B	10650
BS03	BURNT SOIL III	8.25	D	15B	10700
DUST	DUST	40.5	D	15B	10550
FOAM	FOAM	94.125	D	15B	10450
FOCA	FOAM CAPPING	35	D	15B	10200
GBAN	GORDON BANKS	120.66	D	15B	10700
HIBB	HEARTH BELOW BAADE	5	D	15B	10450
HIAS	HEARTH IN ASHES	4.75	D	15B	10600
SMOH	HEARTH IN SMOKE	2.5	D	15B	10500
HASH	HOLE IN ASHES	0.3	D	15B	10600
LEYA?	LEV YASHIN		D	15B	10700
OXYG	OXYGEN	12	D	15B	10450
PBGB	PALE BURNT GORDON BANKS	91	D	15B	10650
PIAS	PIT IN ASHES	9.5	D	15B	10600
SMOK	SMOKE	58.25	D	15B	10500
VIKI	VIKING	9	D	15B	10200
BEFO	BELOW FOREIGNER	11.5	D	15C	10150
FORE	FOREIGNER	12.5	D	15C	10150
STRA	STRANGER	15.5	D	15C	10150
AFPA	ABOVE FIRST PALE ASH	5	D	16A	10800
BEDE	B. DEVLIN	11.05	D	16A	10800
BRSS	BROWN SOIL SURFACE	20	D	16A	10800
CBCA	CED'S BIRTHDAY CAKE	17	D	16A	10800

ACRONYM	UNIT NAME	NUMBER OF BUCKETS	PULSE	PACKAGE	AGE
FIPA	FIRST PALE ASH	23	D	16A	10800
KAMA	KARL MARX	98.25	D	16A	11050
LOOS	LOOSE BROWN SOIL = GBS?	7	D	16A	10900
PLGB	PATELLA LENSE IN BASE OF G.BAN	9.5	D	16A	10750
SLAG	SLAG	6.75	D	16A	10800
SP01	SPIT I	30.55	D	16B	
SP02	SPIT II	52.05	D	16B	
SP2B	SPIT IIB	9	D	16B	
GB1A	GBS 1A	9.75	D	16C	11370
GB1B	GBS 1B	28.5	D	16C	11370
GB1C	GBS 1C	12.5	D	16C	11370
GBSO	GBS O	2.5	D	16C	11370
GBSH	GBS ONE AND A HALF	11	D	16C	11370
GBS1	GREY BROWN SOIL SERIES I	53	D	16C	11370
HBGB	HEARTH IN BASE OF GBS 1	2.25	D	16C	11370
HG1A	HEARTH IN GBS 1A	3.5	D	16C	11370
LGB1	LIMPET LENSE IN GBS 1	7	D	16C	11370
BGBS	BASE OF GBS	8	D	17A	13020
GBS2	GREY BROWN SOIL SERIES II	59.25	D	17A	13020
HGB2	HEARTH IN GBS II	16.05	D	17A	13020
GB2A	GBS IIA	17.75	D	17A	13020
SP03	SPIT III	59.75	D	17B	
DS01	SOUNDING: SPIT I	24	D	17C	11700
DS02	SOUNDING: SPIT II	22	D	17C	12450
OBS2	ORANGE-BLACK SERIES II	84	D	18A	13100
OBS1	ORANGE-BLACK SERIES I	46	D	18B	13100
SOSA	SOFT SERIES IA	2	D	19A	13260
SOSE	SOFT SERIES I	120	D	19A	13260
CSS1	CALCIFIED HOLE IN SS1	1	D	19A	13260
SOS2	SOFT SERIES II	4	D	19A	13260
SP04	SPIT IV	18.5	D	19B	
DS03	SOUNDING: SPIT III	27.25	D	19B	
MOS1	MOTTLED SERIES I	20.25	D	20A	13600
DS04	SOUNDING: SPIT IV	20.75	D	20B	
KALL	KALLIE	1	E	21A	17800
SPIN	SPINKS	2	E	21A	17800
OAKO	OAK	3	E	21A	20500
LIME	LIME	6	E	21A	20500
SP05	SPIT V	6	E	21B	
SP06	SPIT VI	7.5	E	21B	
DS05	SOUNDING: SPIT V	27.75	E	21C	
DS06	SOUNDING: SPIT VI	25.5	E	21C	20180

ACRONYM	UNIT NAME	NUMBER OF BUCKETS	PULSE	PACKAGE	AGE
GERR	GERRIE	1.25	F	22A	
SPAL	SPALL	6	F	22A	
TAPT	TAP TAP	10.25	F	22A	
DS07	SOUNDING: SPIT VII	25	F	22B	
DS08	SOUNDING: SPIT VIII	23	F	22B	
NORT	NORTON	12.75	G	23A	
BANO	BASE OF NORTON	2	G	23A	
PATT	PATTERSON	8.5	G	23A	
LUSK	LUKE SKYWALKER	4.75	G	23A	
DS09	SOUNDING: SPIT IX	25	G	23B	
DS10	SOUNDING: SPIT X	13	G	23B	
DS11	SOUNDING: SPIT XI	18	G	23B	
DAVA	DARTH VADER	1	H	24	
CRAC	CRACK	16	X		
REAR	REAR OF CAVE	36.5	X		
UNMO	SCRAPINGS FROM UNEATEN MUSS	0.5	X		
BASR	BASIN RIM	6	X		
LOAM	LOAMER	3	X		
MUSC	MUSCLE	10.25	X		
SUTR	SURFACE TRAMPLING = SOLE?	14.25	X		
JIMO	JIM MORRISON	9.25	X		
PHIL	PHIL	7	X		
ARST	AROUND STONES	3	X		
ASH1	ASH LENS 1	3	X		
LIZO	LIZ	4.25	X		
FITO	FIRE TOP	1	X		
GASB	GREYISH ASH WITH SHELL AND BE	2	X		
HIPI	HEARTH IN PIT	2.5	X		
GBSX	GBS (X)	2	X		
GSBH	GREEN SOIL BETWEEN HOLES	2.5	X		
SKHA	S. KHAN	3.75	X		
CLGS	CLEANINGS	110.15	X		
SCRA	SCRAPINGS FROM BROWN SURFAC	10.75	X		

<u>COMPROMISED UNITS - The following units were later added together as it was decided that the divisions between them were rather doubtful.</u>

EDDI	EDDIE BARLOW	165.175	A	3B	1050
BEDI	EDDIE BARLOW (BURNT)	21.625	A	3B	1050
EBHE	EDDIE BARLOW (HEARTH)	3.125	A	3B	1050
EBTP	EDDIE BARLOW (TWIGGY PATCH)	9	A	3B	1050
BARR	BARRY RICHARDS (UPPER)	20	A	4A	1350
BARI	BARRY RICHARDS (LOWER)	20	C	6	3400
LBED	LOWER BARLOW EDDIE	54.75	C	6	3500
UBED	UPPER BARLOW EDDIE	4.75	C	6	3400

SUGGESTED COMBINATIONS OF UNITS

BARN*	BARNACLES FROM REAR OF CAVE	2.5	A	3A	950
BEDP*	BEDDING PATCH (NOT DOLLY)	34	A	3A	900
DOLL*	DOLLY	66	A	3A	950
DOL2*	DOLLY SPIT II	36.25	A	3A	950
DOSU*	SURFACE OF DOLLY	32	A	3A	950

ACRONYM	UNIT NAME	NUMBER OF BUCKETS	PULSE	PACKAGE	AGE
SDUN*	SURFACE AND DUNG	16.75	A	3A	950
SURF*	SURFACE	11.3	A	3A	950
TOTAL	ALLD	198.8			
WE PROPOSE TO CALL THIS DOLL					
BSJF*	BROWN SOIL IN JOE FRAZIER	13.25	C	8A	3750
JOFR*	JOE FRAZIER	174.875	C	8A	3750
JFR1*	JOE FRAZIER I	68	C	8A	3750
JFR2*	JOE FRAZIER II	46.25	C	8A	3750
LMLE*	LOUIS AND MARY LEAKEY		C	8A	3850
LSBL*	LSB LEAKEY	23.5	C	8A	3850
MDLE*	MARY D. LEAKEY	23.75	C	8A	3850
TOTAL	ALLJ	349.625			
WE PROPOSE TO CALL THIS JOFR					
JVOR*	JOHN VORSTER		D	10C	8850
PKER*	PAUL KERES		D	10C	8050
PELE*	PELE	132.25	D	10C	8500
TOTAL	ALLP	132.25			
WE PROPOSE TO CALL THIS PELE					
ELPR	ELVIS PRESLEY	29.625	A	3D	1350
JECH	JESUS CHRIST	162.5	A	3D	1350
LIAP	LENS I ABOVE PIT	25	A	3D	1300
TCHA	TCHAIKOVSKY	19.5	A	3D	1350
TOTAL	ALLC	236.625			
WE PROPOSE TO CALL THIS JECH					
RAYI*	RAY INSKEEP	19.5	B	5A	1550
MIJA*	MICK JAGGER	55	B	5A	1550
FRRI*	FIRE BELOW RR1	1.5	B	5A	1550
DOLA*	DOROTHY LAMOUR	81.1	B	5A	1550
CKEE*	C.KEELER	33.25	B	5A	1550
DAKA	D.KAYE	3	B	5A	1550
ALAG	ASH LENS ABOVE GERMAINE GREE	4.5	B	5A	1550
TOTAL	ALLK	197.85			
WE PROPOSE TO CALL THIS DOLA					
CCLA	CASSIUS CLAY	36.5	A	3B	1000
GEOB	GEORGE BEST	71.25	A	3B	1000
TOTAL	ALLG	107.75			
WE PROPOSE TO CALL THIS GEOB					
ALEN?	ASH LENS	31.5	A	3C	1100
ALMJ	ASH LENS ABOVE MICK JAGGER	4	A	3C	1150
BING	BING CROSBY	16.35	A	3C	1100
BHOP	BOB HOPE	5	A	3C	1150
BRST	BRIAN STATHAM	32.25	A	3C	1250
TOTAL	ALLB	89.1			
WE PROPOSE TO CALL THIS BRST					
GEGR	G.GREER	13	B	5C	1750
EVGO	EVONNE GOOLAGONG	7.85	B	5C	1750
APAT	ALAN PATON	2.5	B	5C	1750
LARM	LOUIS ARMSTRONG	62.5	B	5C	2200
TOTAL	ALLL	85.85			
WE PROPOSE TO CALL THIS LARM					

ACRONYM	UNIT NAME	NUMBER OF BUCKETS	PULSE	PACKAGE	AGE
GSFB?*	GREYISH SOIL WITH FRAG. BEDDIN	24	C	6	3600
RING?*	RINGO STARR	20	C	6	3550
TOTAL	ALLR	44			
WE PROPOSE TO CALL THIS RING					
TOPD	TOP OF DOLLAR BRAND	13.5	C	8B	3800
DBRA	DOLLAR BRAND	31	C	8B	3800
H?DB	HEARTH IN DOLLAR BRAND	0.5	C	8B	3800
TOTAL	ALL$	45			
WE PROPOSE TO CALL THIS DBRA					
BSBP	BROWN SOIL BELOW PELE	183.5	D	13	9550
BSJH	BROWN SOIL BELOW JIMI HENDRIX		D	13	9550
BSP1	BSBP I	16.5	D	13	9550
BSP2	BSBP II	12.25	D	13	9600
JIHE?	JIMI HENDRIX		D	13	
TOTAL	ALLS	212.25			
WE PROPOSE TO CALL THIS BSBP					
TOPG*	TOP OF GNOME	1	D	12	9500
GNOM*	GNOME	35	D	12	9500
GNO2*	GNOME II	1	D	12	9500
TOTAL	ALLO	37			
WE PROPOSE TO CALL THIS GNOM					
HOLE*	HOLE	18.5	D	11A	8900
HOCO*	HOLE CONTENT	14	D	11A	8900
LITH	LENSE IN TOP OF HOLE	1	D	11A	8900
TOTAL	ALLH	33.5			
WE PROPOSE TO CALL THIS HOLE					
PARO*	PAUL ROBESON	28.5	D	10C	8300
PAR1*	PAUL ROBESON I	22.5	D	10C	8300
TOTAL	ALLA	51			
WE PROPOSE TO CALL THIS PARO					
BERO*	BEDDING ROBESON	33.5	D	10A	8400
BER1*	BEDDING ROBESON I	4	D	10A	8400
BER2*	BEDDING ROBESON II	2.5	D	10A	8400
TOTAL	ALLB	40			
WE PROPOSE TO CALL THIS BERO					
SHA2*	SHAKA II	7.5	C	9	4350
SHAK*	SHAKA	165.5	C	9	4350
TOTAL	ALLY	173			
WE PROPOSE TO CALL THIS SHAK					
WAYA*	DINGISWAYO A	20.5	C	9	4300
WAYB*	DINGISWAYO B	5.125	C	9	4300
TOTAL	ALLW	25.625			
WE PROPOSE TO CALL THIS WAYA					

Appendix 3

The Predators : Habits and behaviour

The following information was complied in order to supplement the analyses done on the microfaunal assemblages from Elands Bay Cave and to aid in the interpretation of the results.

The Owls

THE CAPE EAGLE OWL (*Bubo capensis*)

Habitat and Habits: The race of Cape Eagle owl, *Bubo capensis capensis,* found in South Africa is the smallest of the three races found in Africa, (Steyn 1984). The Cape Eagle owl is usually found at altitudes above 2000m, although, in the southern cape province it is found at sea-level (Steyn 1982). This species current distribution does not extend very far north of Cape Town but it is not impossible that it may have occurred in the Elands Bay area at some stage in the past. This owl is usually associated with rocky and mountainous areas but it has also been seen in the open Karoo and it would appear that it can live in a more arid environment than was previously considered suitable (Steyn 1984). This owl is thus a potential accumulator of the microfauna at Elands Bay Cave.

The Cape Eagle owl nests in a position protected by bushes or rocks on the ground, on stone ledges, or in caves with a drop below (Steyn 1982; Steyn 1984). Like the Barn owl, the nest is just an area scraped out on the ground (Steyn 1984). In Kenya it has also been recorded nesting in tree forks or stumps (Steyn 1984). The nest site is used yearly, providing there is no breeding failure, and large collections of pellets and bones accumulate (Steyn 1984). If it comes out during the day it is likely to be mobbed by white-necked ravens or other birds occuring in the same habitat (Steyn 1982). However, it has also been reported as being somewhat diurnal, even attacking prey during the day (McLachlan and Liversidge 1976).

Food: It is a specific feeder and usually feeds predominantly on one large species (Steyn and Tredgold 1977; Avery *et al.* 1985). Red rock hares, rock dassies, yellow-spotted rock dassies, scrub hares, springhares, hedgehogs, genets, civets, mongooses, tree squirrels, golden moles, cane rats, vlei rats, rats, mice, shrews and rock elephant shrews are all prey items taken by the Cape Eagle owl (Steyn 1982). Juvenile dassies are usually taken and it has been suggested that this is because the adults are large enough to defend themselves (Steyn and Tredgold 1977). A wide range of birds are taken , including the barn owl. Other prey items are small lizards, scorpions, spiders, sun spiders, grasshoppers, beetles and fresh-water crabs (Steyn 1982). Steyn (1982) notes that much of the prey taken is clearly associated with the rocky, mountainous environment of the bird. The skulls of rock hares were characteristically fragmented in that the skull was intact but the cranial and nasal areas were broken (Steyn 1984).

THE SPOTTED EAGLE OWL (*Bubo africanus*)

Habitat and Habits: This owl is the smallest of the three African eagle owls and its pellets are much smaller than those of the Cape Eagle owl and contain smaller bones (Steyn 1982). It adapts to a wide variety of habitats and even breeds on buildings in urban areas, though it is commonest in rocky areas.

These owls roost in pairs (they mate for life), in a tree or on the ground and the same nest may be used for many years (Steyn 1982). The male provisions the female when she is incubating and, to a large extent, when the chicks are hatched (Steyn 1984). The female then tears up the prey for the chicks in the early stages. Prey is usually brought decapitated to the chicks. At three weeks the chicks are able to swallow small rodents whole (Steyn 1982). They usually remain on the nest site for some six weeks (Steyn 1982).

An analysis of 359 records of roost sites indicated that 61% of the sites were ground sites, 26% in trees and 11% on buildings (Steyn 1982). Nests are found set amongst rocky outcrops or on ledges, small cliffs or eroded dongas. Around habitations, the ledges of buildings, the top of gutters, down pipes or ornamental window boxes are used (Steyn 1982). It may live in closed woodland but it shuns forests (Andrews 1990a). The presence of people does not appear to bother the birds and Steyn (1982) notes that some female birds when nesting on buildings become so used to people that they refused to leave the nest and have to be pysically lifted up so that their nests could be examined. Andrews (1990a) writes that the nocturnality of this owl biases the prey assemblages against diurnal prey, however, in the Kalahari an owl was seen following a foraging honey badger during the day (Steyn 1982). Mendelsohn (1989) notes that on the Springbok flats, the spotted eagle owl hunted from perches and this resulted

in their exclusion from areas lacking trees or perches. Pellets are loosely compacted and are approximately the same size as Barn owl pellets. Andrews (1990a) analysed only a single roost site for this species.

Food: Arthropods (locusts, grasshoppers, crickets, beetles and termites, scorpions, spiders, millepedes and, rarely, fresh water crabs) small mammals (mainly rats, mice, shrews, mole-rats and moles) and birds and occasional amphibians, reptiles (small snakes, lizards and reptiles) and fish and possibly carrion (Steyn 1982). Large birds such as the lanner, francolins, pigeons and sandgrouse have been recorded and mammals as large as the night ape and young hares are taken (Steyn 1982). Generally, however, the spotted eagle owl feeds mainly on insects and small mammals and birds, the latter two forming the main prey items when the owls are breeding (Steyn 1982). Species such as *Tachyorcytes* and *Tatera,* with a size range of 100-140g, are taken (Steyn 1982).

GIANT/VERREAUX EAGLE OWL (*Bubo lacteus*)

Habitat and Habits: This owl is also known as the Verreaux Eagle owl. This owl is the largest of the African owls. It is found in savanna woodland (especially in acacia) and in riverine strips where there are large trees (Steyn 1982). It occurs mainly in drier areas and is not found in forests (Steyn 1982). This owl's current distribution extends from George and up the east coast of South Africa and is not found on the West coast. However, McLachlan and Liversidge (1976) note that it was recorded in an old record in Somerset West. It is not impossible that at some stage in the history of Elands Bay Cave this owl lived in the area and this species is a potential accumulator of the microfauna at Elands Bay Cave.

The owls usually roost in pairs and may remain in the same small area for many years (Steyn 1982). Kills, presumably opportunistic, have been recorded during the day (Steyn 1982). Andrews (1990a) contradicts this observation when he notes that it is a strictly nocturnal hunter and as a result fails to sample diurnal rodents. The owl risks being mobbed by diurnal predators and other birds when coming out during the day, however, and it usually begins hunting at dusk (Steyn 1982). As with the Cape eagle owl, Andrews (1990a) notes that no information on food intake or pellet production is available.

This species often poaches the nests of other birds and may return to the same nest site year after year (Steyn 1982). The pellets of this species are large and break down easily due to their loose construction (Steyn 1982: Andrews 1990). Andrews (1990a) notes that due to the break up of the Verreaux pellets he collected, it was impossible to ascertain how many bones came from one pellet.

Food: This owl is an opportunistic feeder and is remarkable for its large prey size range (Andrews 1990a). This owl can kill prey as large as vervet monkeys and other owls (including the Barn, Marsh, Grass and Spotted eagle owl), however, it also takes remarkably small prey such as insects and shrews (Steyn 1982). Steyn (1982) writes that it will feed on almost anything it can catch and the following list of prey items give us some idea of its great variability; warthog piglet, hares, springhares, genets, mongooses, suricates, dassies, galagos, ground squirrels, fruit bats, cane rats, gerbils, rats, mice, lizards, snakes, fish, scorpions and insects. It has also been observed taking carrion Avery (*et al.* 1985). It catches a wide range of birds, from the large secretary bird to the small white-eye (Steyn 1982). Andrews (1990a) notes that the most common prey in the pellets he examined were insectivores and small rodents. Avery (*et al.* 1985) in their observations of this owl in the De Hoop Nature Reserve found that birds provided a large proportion of prey mass (57.8%), (thiswas unusual as mammals are usually predominant) and mammals provided 41.1% of the mass. The Common molerat and field mouse and striped polecat made up 66.7% of mammalian prey of this bird at De Hoop nature reserve Avery (*et al.* 1985). Andrews (1990a) noted that hedgehogs are favoured prey. This opportunistic owl differs from the more specialised Cape Eagle Owl.

The female may tear up prey into edible chunks for the nestling (Steyn 1982). The young leave the nest when about 2 months old (Steyn 1982). The juvenile owls remain with their parents until the next breeding season (Steyn 1982).

THE MARSH OWL (*Asio capensis*)

The Marsh owl is the only gregarious South African owl and has a number of temporary roosting sites in its home range (Steyn 1984). Its current distribution does not extend as far north as Elands Bay Cave. The nests consist of hollows in the grass with a few pellets (Steyn 1984). It eats small birds and mammals, occasional frogs and lizards and insects (Steyn 1984). The Marsh owl was observed to make a prey switch from rodents to that of insects during summer when rodents became scarce (Mendelsohn 1982b; Mendelsohn 1989). This owl is not a candidate for the accumulation of microfauna in cave sites due to its nesting habits.

THE WOOD OWL (*Ciccaba woodfordii*)

This owl is the only species found regularly in true forest but it also occurs in woody, riverine areas, thick coastal bush and plantations and it ranges from sea-level to montane forest (Steyn 1984). Its current distribution does not extend as far north as Elands Bay Cave. It is not a potential candidate for the accumulation of bones at archaeological sites as it nests in trees.

THE BARN OWL (*Tyto alba afinis*)

Habitat and Habits: Some 34 subspecies of Barn owl have been found world-wide. The race of Barn owl found in South Africa is *Tyto alba afinis* (Steyn 1984). The Barn owl is extremely adaptable and is found all over southern Africa. This owl is a potential accumulator of the microfauna at Elands Bay Cave.

The roost site of the Barn owl may be used for nesting or may be near a site later chosen for nesting (Prestt and Wagstaffe 1973). Steyn (1982) notes that the Barn owl uses the same roost year after year and is a useful collector of micromammals for palaeoenvironmental research. The Barn owl does not build a nest and Steyn (1984) notes that he observed that the nest site often consisted of only a few broken down pellets scraped together on the ground. The Barn owl has been noted to make use of the nests of other birds, such as the Hamerkop (Wilson 1988; Taylor 1994), but also roosts in buildings, hollow trees, caves and overhangs.

The male provides the female with food when she is incubating the eggs and she does not leave the nest (Steyn 1984; Taylor 1994). Barn owl chicks can swallow small prey items whole by the time that they are 3 weeks old (Steyn 1982). Young owls eat more frequently than their olders and pass a larger number of pellets (Read and Allsop 1995). The young owls return to the nest to roost for a week after their first flight (Steyn 1982). Adult owls swallow their prey whole and dismember items too large to swallow, similarly, young birds are fed dismembered prey pieces by the adults until they are able to feed themselves (Andrews 1990a).

This owl is a silent and efficient hunter, catching its prey in mid-flight and killing it by crushing its head with its beak (Prestt and Wagstaffe 1973). The Barn Owl is almost entirely nocturnal, though they have been seen hunting on dull days (Steyn 1982). In the UK and Scotland they have been seen hunting after sunrise and before sunset, but such behaviour has not been recorded in South Africa (Steyn 1982; Taylor 1994). If the Barn owl ventured out during the day in Africa it could fall prey to Wahlbergs eagle, the Tawny owl, African Hawk eagle, Cape Eagle owl or Giant Eagle owl (Steyn 1982; Steyn 1984).

Food: African Barn owls rely heavily on rodents for food and Taylor (1994) notes that they usually form 80-90% of all the items consumed. The diet of the African Barn owl is much more diverse than its European counterpart (where voles make up most of the biomass eaten) with as many as 10 different small mammals being taken from the hunting range, these forming some 80% of the diet biomass.

The main prey item of the Barn owl is generally the most common species in the area falling within a certain size range (usually a soricid or murid) but small birds, bats, frogs, insects and also fish are consumed (Prestt and Wagstaffe 1973; Andrews 1990a). Steyn (1982) adds hares to this list, though they are rarely taken. Andrews (1990a:180) writes, "...within the limits of the microtine-murid-soricid group, barn owl prey gives an accurate representation of the species composition of that part of the small mammal community". Andrews (1990a) also notes that six or more species may be represented along with the specie/s which are dominating the assemblage and concludes that within the microtine-murid-soricid groups available, the barn owl takes prey from these groups in proportion to the relative availability of these species. Taylor (1994) notes that the Barn owl diet is usually dominated by a small number of species but also includes a number of numerically unimportant other species which may be taken regularly or sporadically. Andrews (1990a) notes that some 90% of prey is taken from the microtine-murid-soricid group, and birds, amphibians, reptiles and fish contribute towards 10%.

Dean (1973) found *Praomys natalensis* to be the staple item in the diet of the Barn owls whose pellets were collected near Warmbaths, Transvaal and found that *Tatera* and *Otomys* counts were in inverse proportion to the bird prey taken (Dean 1973). Taylor (1994) notes that *Praomys natalensis* and the gerbil genera are the most important main prey species throughout most non-arid and semi-arid regions, respectively. Shrews are the most common non-rodent prey in all but arid areas. Taylor (1994).writes that, Otomys *irroratus,* the vlei rat, and other members of this genus are taken widely, often constituting the main prey species. In the Transvaal, up to 25 small mammal species were taken regularly by Barn owls (Taylor 1994). The numbers of prey species taken ranges from 2-25 in different areas, thus the foraging niche width can be seen to be very varied (Taylor 1994).

In coastal Namibia, avian prey (in the form of palaeoartic waders) composes 25% of vertebrate prey of the Barn owl (Steyn 1982). Taylor (1994) notes that birds are a common component of the Barn owl diet in Africa. The lizard often appears but its relative unimportance may be related to its diurnal activity (Taylor 1994). In the Transvaal and Natal the Multimammate mouse is the favourite prey item and, together, shrews and rodents usually make up about 80% of the prey taken (Steyn 1982). Taylor (1994:63) writes, "Nearly all the Barn owl's main prey species have one very important characteristic in common, their numbers vary greatly with season and from year to year". It would appear that in the case of the Barn owl its feeding strategy has adapted to cope with change. Goodman *et al.* (1993) note that even when looking at a small geographical area, with small differences in the local habitats, a comparison of the food habits of the Barn owls inhabiting those areas may show pronounced differences.

Steyn (1982) notes that studies in the Transvaal have shown that the Barn owl diet is subject to seasonal variation, with mammals constituting the sole prey during the winter months (June - August) and with birds, arthropods and micromammals being hunted the rest of the year, especially in the summer. Taylor (1994) also writes that, in most areas of its distribution, the Barn owl's diet varies seasonally (as does its hunting methods) while longer term changes may occur in the availibility/abundance of a specific prey item. Van der Merwe (1980) notes that the study of Barn owls in the southern Transvaal Highveld showed that there was an increase in the number of bats eaten, coinciding with periods of decrease in the subterrestrial and terrestrial prey species available.

Perrin (1982) notes that the Barn owl catches prey within the 9-100g size range (though it catches prey mainly within the 40 - 50g size range) and Taylor (1994) cites 27-63g as the range of food taken by the African Barn owl. He notes that the lower values are from prey taken from arid areas dominated by gerbilles and the higher values from areas where the multimammate mouse is most common, very small sized prey are avoided. Perrin (1982) also notes that very small species such as *Mus minutoides* may be avoided and suggests that this may be because they represent minimal returns in terms of their size while with the larger species, such as *Georychus Capensis,* only juveniles are taken. In a feeding experiment the Barn owl preferred smaller prey and 95% of the prey taken weighed less than 100g and the prey selected had a range of 25-164g (Morris 1979). Taylor (1994) notes that the very young animals of a species are often under-represented and notes that this may be because they are less active and not yet involved in sexual or territorial defence activities and therefore less prey to predation. Barn owls have extremely sensitive hearing and Taylor (1984) notes that there is a possibility that they may be able to use sound to distinguish between the age and sex classes of prey.

THE GRASS OWL (*Tyto capensis*)

There have been records of this owl appearing in the south western Cape (Steyn 1984). It is closely related to the Barn owl but it occupies an entirely different habitat (Steyn 1984). Though it catches species similar to the Barn owl, the Barn owl is more catholic. This owl roosts in pairs in grass nests on the ground and though it accumulates pellets at its roost site, it is not a likely candidate for the accumulation of pellets in any cave site as it is usually found in areas of long grass, near water (Steyn 1982).

Diurnal Birds of Prey

The most common diurnal birds of prey with current distribution ranges in the area of Elands Bay Cave are listed below. The diurnal birds of prey are unlikely accumulators of microfauna as diurnal birds do not usually roost in caves, an exception to this rule is the Golden eagle, a European species, which may sometimes roost in small caves (Andrews 1990a). The majority of diurnal birds of prey nest in trees and would not therefore by likely to be responsible for accumulations of microfauna in caves. Large samples of micromammals are also unlikely to accumulate where a diurnal bird of prey is roosting as the pellets usually contain very small samples of rather fragmented bone.

Blackshouldered kite (*Elanus caeruleus*): Prefers open country with scattered trees. Nests in trees and eats mice insects, lizards, rats, moles etc.

Yellow-billed kite (*Milvus aegyptius*): This species is found throughout southern Africa. Constructs its nest in trees. It eats rats, shrews, lizards, small birds, frogs, large snails, insects, molerats and carrion.

Rock kestrel (*Falco tinnunculus*): Common in mountainous, rocky areas (Sinclair 1994). This species usually breeds on cliffs, buth they may take over other species deserted nests in trees. This species eats insects, small mammals, lizards and sometimes birds (McLachlan and Liversidge 1976).

Greater kestrel (*Falco rupicoloides*): This species is usually found nesting on cliff ledges but may also nest in trees and may even be found in towns, nesting on buildings (McLachlan and Liversidge 1976).

Lesser kestrel (*Falco naumanni*): This kestrel is a migrant from Asia and Europe and may be found roosting in trees in large groups. Its diet consists mainly of insects (McLachlan and Liversidge 1976).

African marsh harrier (*Circus ranivorus*): This species nests in marshes or reeds and eats frogs, water-rats, young chicks and wounded birds (McLachlan and Liversidge 1976).

Black harrier (*Circus maurus*): This harrier is found near vleis, rivers and dams and eats frogs, lizards, rodents and young birds (McLachlan and Liversidge 1976). This harrier nests in marshy vegetation.

Black eagle (*Aquila verreauxi*): Found throughout South Africa. Nests are made on ledges of a cliff or a tree. Eats mainly dassies, also takes ground birds, small antelopes and young baboons.

Black-breasted snake eagle (*Circaetus pectoralis*): This eagle is found throughout southern Africa but is rare in the south west Cape. Nests in trees and eats mainly snakes, also lizards and small mammals, even bats.

African hawk eagle (*Hieraaetus spilogaster*): This bird is found in mountainous or open country and nests in trees. It eats game birds, squirrels, reptiles and small rodents.

Martial eagle (*Polemaetus bellicosus*): This bird is found in drier areas, both mountainous and open. This species constructs nests I trees and eats mainly ground squirrels and dassies, but also game-birds, hares, rodents, rodents and monkeys.

The Viverrids

The Viverridae family consists of generalist carnivores with relatively simple dentitions which differ from the 'strictly carnassial' teeth of the canids and felids (Andrews and Evans 1983). Andrews (1990a) notes that viverrid scat latrine areas are quite common as they frequently mark their territories with their scats.

Yellow Mongoose (*Cynictis Pencillata*)

Habitat and Habits: This species prefers open areas such as semi-desert scrub and short grassland. It is found in the coastal and more open habitats of the coast in the western and eastern Cape and avoids forest, the coastal Namib desert and areas of dense vegetation (Stuart and Stuart 1988). This species is diurnal (Stuart and Stuart 1988) but there have been reports that it is sometimes active at night (Herzig-Straschil 1977). This species wanders relatively far from its burrow as compared with other species such as Selous' mongoose and the Bushy-tailed Mongoose (Smithers 1983).

Latrines accumulate near the entrance of the communal burrow in which 5-20 individuals may live communally (Stuart and Stuart 1988). This species excavates its own burrows, but whether they take over old burrowing systems and renovate them or dig them themselves is uncertain (Smithers 1983). They often share their burrows with other species such as the suricate or ground squirrel (Smithers 1983).

Food: Locusts, termites (in an area with high termite densities the Yellow mongoose was observed to eat many termites) and other invertebrates are eaten by the Yellow mongoose as are mammals, birds, amphibians, plants and carrion (Herzig-Straschil 1977). Smithers (1971) found insects to be the primary food item consumed, with murids second in importance.

WHITE-TAILED MONGOOSE (*Ichneumia albicauda*)

Habitat and Habits: This mongoose was not a candidate for the deposition of scats at EBC as it is found only in the eastern area of the Southern African subregion (Stuart and Stuart 1988), however, it is relevant because Andrews (1990a) analysed a single scat collection of this species. This mongoose is one of the largest species of viverrid viverrids and appears to select against the smaller species of rodent prey as there is some suggestion that it might select for medium-sized, single species prey (Andrews 1992). It has a narrow, tapering, pointed snout and teeth which lack highly developed carnassials which means it relies more on crushing than cutting its prey

(Andrews 1990a). An investigation of white-tailed mongoose scats by Andrews & Evans (1983) showed a high percentage loss of body parts and it appears that well over a third of the bones are lost during consumption and digestion. Cranial bones are under-represented and this could be due to the predator sometimes not eating the head of its prey (Andrews and Evans 1983).

SMALL GREY/ CAPE GREY MONGOOSE (*Galerella pulverulenta*)

Habitat and Habits: Found in a variety of areas; fynbos, grassed glades, stands of keurboom, in very dry scrub forest and areas of moist dry forest (Crawford *et al.* 1983). This animal shows a wide habitat tolerance but is particularly common in the southern coastal areas and the adjoining interior (Stuart and Stuart 1988).

This mongoose is usually solitary except during mating and rearing of young. It is most active in the morning and from late afternoon to dusk part (Stuart and Stuart 1988) and it has been suggested that this is to fit in with the activity patterns of one of its main prey items, *Rhabdomys pumilio* (Crawford *et al.* 1983). It is also more active from late autumn through early spring and this may be due to an increased seasonal abundance of particular prey such as *Rhabdomys pumilio* (Crawford *et al.* 1983). This species is diurnal and shelters during the night in deserted burrows, rockpiles, and holes and crannies in rock outcrops (Smithers 1983). Small mice are chewed in the side of the mouth for maximum cutting use of the carnassial teeth. Larger prey are torn apart, and then the pieces cut up with the teeth prior to swallowing (Smithers 1983).

Food: Mainly insects and other invertebrates, small rodents (murids), carrion, birds, reptiles, amphibians and wild fruits (Stuart and Stuart 1988). Smithers (1983) notes that insects are their main food source. Percentage occurrence of Insecta was found to be 66% and Muridae 52% in an examination of 44 stomachs of the small grey mongoose.

LARGE GREY MONGOOSE *(Herpestes ichneumon)*

Habitat and Habits: This mongoose often moves in pairs or family groups (Smithers 1983). This species does not occur in the Elands Bay area today, however, remains of this species found in Elands Bay Cave clearly indicate that it lived in the environs of Elands Bay Cave in the past. This species frequents areas of riparian vegetation and is found near reed beds, the banks of lakes, dams and swamps and may hunt in shallow water. This species is an efficient digger. This mongoose may also wander into nearby dry terrain when foraging. Smithers (1983) notes that there is some debate over whether this mongoose is nocturnal with some diurnal activity, or largely diurnal. In the northern areas of Southern Africa, however, they are clearly diurnal.

Food: The large grey mongoose feeds on murids, snakes, fish, frogs, crabs, mammals, brids, reptiles and insects (Stuart 1983). Scats were collected over the period of a year from midden sites and their contents anaylsed (Stuart 1983). Plant material was frequenly found in the scats with green grass found in 43.8% of scats and dry grass in 18.09% (Stuart 1983). Shrews, snakes, a felid kitten, birds, eggs, fish, crab, arachnids, millipedes, gasteropods, molluscs, Coleoptera and Orthoptera were also found (Stuart 1983).

WATER MONGOOSE (*Atilax paludinosus*)

Habitat and Habits: This mongoose is found near water, along rivers, streams, dams, lakes, swamps, estuaries and temporary stream beds where pools occur. It may be found some distance away from water (Stuart and Stuart 1988). This mongoose is mainly nocturnal but is also occasionally crepuscular. They are a terrestrial and solitary species, though females may be accompanied by young (Smithers 1983). Scats usually accumulate at latrines around the waters edge which suggests that this species is not a likely accumulator of the microfauna from Elands Bay Cave (Stuart and Stuart 1988).

Food: This species subsists predominantly on crabs and amphibians but also eats small rodents, birds, reptiles, fish and wild fruit (Stuart and Stuart 1988). The percentage occurrence of various food items in 19 stomachs was Amphibia 32, Crustacea 26, Muridae 26, Insecta 21 and Pices 5 (Smithers 1983). Rodents species found were: *O. angoniensis, Praomy natalensis* and *Mus minutoides.*

SMALL SPOTTED GENET (*Genetta genetta*)

Habitat and Habits: This species has a wide habitat tolerance and is found in areas which range from extreme aridity to areas with a high rainfall, including woodland.

This species is strictly nocturnal and predominantly terrestrial, resting in hole in the ground during the day (Smithers 1983). They may also shelter in hollow trees or in piles of boulders (Smithers 1983). Home ranges vary from approximately 1-2 km (Andrews 1990a). Droppings are accumulated at latrine sites which are usually in open areas, depressions or thick bush (Stuart 1977; Andrews and Evans 1983).

Food: The Genet shows a preference for the smaller rodent species available and small lizards, fish and amphibians are consumed (Andrews and Evans 1983). Stuart (1977) cites Smithers (1971) who wrote that muridae were the most common prey species for the above in Botswana. The incidence of plant foods is generally low (Smithers 1971). Andrews and Evans (1983) conclude that the Genet would give an accurate indication of the fauna in an area within a particular size range. Stuart (1977) examined a collection of scats and found that though small mammals (predominantly rodents) dominated the scat contents, most of the bones were fragmented and often impossible to identify. The consumption of Lizard and snake was ascertained from pieces of skin only. Andrews (1990a) notes that the size spectrum of the genet prey assemblage differs from that of the much larger White-tailed mongoose. The latter selects for the larger species of rodent, while the genet selects mainly the smaller species of murid.

Andrews and Evans (1983) note that, as compared to the White-tailed mongoose, this species appears to produce better preserved assemblages. Cranial bones were far better represented than in the white-tailed mongoose samples and bones are not broken to the same degree (Andrews and Evans 1983). Long bones do not appear to be so well represented but the bones present are more complete and show less damage than those of the other carnivores studied (Andrews and Evans 1983). The numbers of cranial specimens are greater, especially the mandibles which are well represented relative to the number of isloated molars and are also relatively complete. Almost all the bones showed some degree of rounding and in some areas heavy corrosion on bones and teeth (with the enamel dissolved) may be seen (Andrews and Evans 1983). Variation in corrosion is seen with only a small area of bone being corroded and with corrosion often occurring on immature bone, such as along the articular surfaces or the epiphyses. Overall, breakage is less but corrosion more than the White-tailed mongoose.

A study of *G. genetta* scats collected during March and December from a rock overhang above a riverbed, showed the following composition: Mammal 96-98%, Birds 5.3%, reptiles 1.3, insects 53-72%, Arachnid 1.3-2% and plant material 6-11% (Stuart 1977). Insect material was abundant in both collections. The stomach contents of two genets from the Kalahari Gemsbok park were found to consist predominantly of reptiles with invertebrates and birds taking up 27.7% and 25.3% of volume respectively (Viljoen and Davis 1973).

SURICATE (*Suricata suricatta*)

Habitat and Habits: Open, arid and lightly vegetated areas (Stuart and Stuart 1988). This species is completely diurnal, not appearing out of their communal burrow (a burrow may contain up to 30 individuals) until the morning sun has reached it (Smithers 1983).

Food: Viljoen and Davis (1973) note that in a study of two suricates from the Kalahari Gemsbok park, invertebrates made up 89.3% of volume of the stomach contents, the remainder being plant food. Stuart and Stuart (1988) note that it eats mainly insects and other invertebrates, but also takes reptiles and birds. Smithers (1983) notes that competition does exist between this species and the yellow mongoose for insects as both are predominantly insectivorous. However, this competition is lessened by the fact that the yellow mongoose ranges over a far larger area when foraging (Smithers 1983).

The Canids

Canids are generalized carnivores with simple premolars and an additional pair of molars in the lower jaw which the Vivveridae do not have. Their molars are used for crushing and there is also some slicing action. The anterior part of the first lower molar and the fourth upper pre-molar of the carnivores have become modified to perform a very efficient scissors-like or break-shear action (Davis 1987). These are termed the 'secodont' carnassial teeth and they are used for cutting meat (Davis 1987).

THE CAPE FOX/SILVER FOX (*Vulpes chama*)

Habitat and Habits: This species is associated with open country, open grassland, or grassland with scattered thickets, or semi-desert scrub (Smithers 1983). Stuart and Stuart (1988) write that this fox is found in open

country such as arid scrub and grassland, wheatlands and in the south-western Cape in the Cape fynbos vegetation zone.

The Cape Fox is mainly nocturnal but also crepuscular at times (Bothma 1966) and is both a solitary and social carnivore (Smithers 1983). This species prefers open areas and lies in dense vegetation and holes during the day (Stuart and Stuart 1988). Burrows may be used to lie in during the day but Smithers (1983) notes that they are more likely to rely on ground surface cover.

Food: Insects, invertebrates, rodents, reptiles, birds, carrion and wild fruit and, very occasionally, new born lambs (Stuart and Stuart 1988). Bothma (1966) investigated the contents of 37 stomachs from around South Africa and found that Rodents were the main source of food followed by carrion, insects, grass (found in 51% of the stomachs) and hares, in that order.

THE BAT-EARED FOX (*Otocyon megalotis*)

Habitat and Habits: This species frequents open areas, such a short scrub and grassveld, and sparsely wooded areas and avoids forests, woodlands and mountains (Stuart and Stuart 1988). The fox can survive in a variety of habitats due to its catholic diet (Mackie and Nel 1989). They show a preference for short grass but in the rainy season when termites are scarcer move into the insect rich, tall grasslands (Mackie and Nel 1989).

This species is both diurnal and nocturnal though it rests during the hottest parts of the day (Stuart and Stuart 1988). Areas around the communal dens may be marked with urine and/or scats (Andrews 1990a). A male and female pair were observed to defaecate approximately 12 times within a radius of 3m around, and at the base, of one bush (Smithers 1983). The Bat-eared fox often excavates its own burrow and lives in small, usually family, groups (Stuart and Stuart 1988).

The home range of complete groups of foxes was larger than that of the young cubs when accompanied only by the male. Females foraging alone during the time she was suckling her young used an even larger area (Mackie and Nel 1989). It would appear that the bat-eared fox can be largely insectivorous but at other times may consume a large number of the smaller species of rodent available. At a site at Lainyamok, Kenya, scats revealed that a small *Gerbillus* species and a small murid contributed 66% and 30% respectively, of rodents eaten (Andrews 1990a).

Food: Kuntzsch and Nel (1992) note that Bat-eared foxes are not specialised feeders and adapt their diet according to availibility of food items. In their study of the Bat-eared foxes in the Karoo National Park they found that wild fruit constituted the main food item during winter and that termites formed only a small part of the diet. Rodents, wild fruit, insects, invertebrates, reptiles (Stuart and Stuart 1988) and grasses are also eaten (Viljoen and Davis 1973; Kuntzsch and Nel 1992). Smithers (1971) notes that in an investigation of the stomach contents of 72 foxes in Botswana the percentage occurrence was as follows: Insecta 88, Scorpiones 22, Muridae 17, Reptilia 14, Wild fruit 14, Solifugae 11 and Myriapoda 7. Smithers (1983) notes that there is great seasonal variation in the diet of this species, with insects dominating the diet during the rainy season while in drier times of the year, mice are the most important item. Viljoen and Davis (1973) note that the relative amounts of plant matter vs invertebrates or animal foods is variable. They do, however, note that a preference for insects and *small* rodents is evident. Berry (1981) notes that the diet of Bat eared foxes in the North western Transvaal varied seasonally. Carrion and nestlings have been found very rarely and probably indicate an opportunistic feeding (Berry 1981).

The Bat-eared fox and the harvester termite require a very similar habitat and Mackie and Nel (1989) note that the distribution maps of both species have a 95% overlap.

A high number of vertebra was found in Bat-eared fox scats and Andrews and Evans (1983) suggest that most of the prey individuals were being entirely eaten. A study of the breakage of bones caused by this fox indicates thorough comminution with few complete limb bones and with only the smallest vertebra and foot bones escaping damage. Little digestive corrosion was observed and it was concluded that there had been little loss of bone due to digestion. Proximal femora and distal humeri dominated the assemblage and this was attributed to their resistance to breakage. Many of the teeth are split and many of the bones have undergone mechanical fracture. Prey size is consistently small with grasshoppers, beetles and small lizards consumed.

BLACK-BACKED JACKAL (*Canis mesomelas*)

Habitat and Habits: This species has a wide habitat tolerance and and is found in areas as diverse as the Namib desert (Hiscocks and Perrin 1987) and the Drakensberg (Stuart and Stuart 1988). This species is found in most areas of the subregion but is commoner in drier areas and absent from forest (Smithers 1983).

Rowe-Rowe (1983) notes that radio-tracked jackals generally became active about an hour before sunset until an hour after sunrise. This species is mainly nocturnal in areas in which there is disturbance from humans, but in reserves it is often seen during the day (Smithers 1971; Stuart and Stuart 1988).

Rowe-Rowe (1983) notes that in the Drakensberg the jackals diet consisted of 55% small mammals (which provided the most abundant and conveniently sized prey) and 9% medium-sized mammals. More food was observed to be eaten by the jackal during the wetter spring and summer months.

Food: The contents of 96 jackal stomachs revealed the following percentage occurrence: insecta 52, carrion 37, muridae 29, vegetable matter 25, solifugae 10, reptilia 7, scorpiones 6, mammalia 5, aves 5, myriapoda 2, amphibia 1 (Smithers 1983). The jackal kills smaller sized animals such as young sheep and goats and scrub hares and also small carnivores such as the large grey mongoose (Smithers 1983). Bothma (1971) found the remains of impala, springbok, reedbuck, duiker, steenbok, shrew, hedgehog, an unidentified wild cat, striped polecat, and a Cape grey mongoose in an investigation of stomach contents of 425 jackals from all over South Africa - rodents were more important in agricultural than in game reserve areas and arachnids were present in 17 cases (Bothma 1971). It is interesting to note that the insects eaten covered a wide range of orders and in some stomachs were the only food found (Bothma 1971). In a study of the jackals in the Addo Elephant Park insects also proved to be a an important source of food (Hall-Martin and Botha 1980). Grafton (1965) notes that in 185 stomachs from all over the country, insects and invertebrates far outnumbered other food items and, on occasion, were the only food taken. This jackal also eats wild fruits and berries (Stuart and Stuart 1988), grapes, groundnuts (Grafton 1965) and ostrich eggs (Hall-Martin and Botha 1980). Tortoises, lizards, snakes, frog and freshwater crabs are eaten in small numbers (Bothma 1971). As can be seen from the above the Black-backed jackal is an extremely opportunistic feeder and will eat whatever is locally available.

Rowe-Rowe (1983) studied scats from the Giant's Castle game reserve in Natal and found that small mammals made up 55% of the prey eaten. An analysis of scats collected near the Namib Desert Research Station, a dry riverine area, indicated that plant food predominated with plant food occurring in 92.3% of all scats and animal food in 77.3% of scats examined (Stuart 1976). Plant food supplied 90.2% by volume of food in the stomachs of two jackals from the Transvaal (Viljoen and Davis 1973).

Bothma (1971) analysed stomach contents from South Africa and found grass eaten as a food item in 25.6% of the stomachs he investigated. Grass made up 11.4 - 40.5% of the stomach contents. Rowe-Rowe (1983) investigated jackal scats from the Drakensberg - the scats analysed were deposited both singly and in middens, but in most cases they were deposited within a small area (Stuart 1976).

AARDWOLF (*Proteles cristatus*)

Habitat and Habits: This animal has a wide range and habitat tolerance and it is found all over Southern Africa in areas where termites are found (Stuart and Stuart 1988). It dislikes forests and shows a definite preference for open habitats (Stuart and Stuart 1988). It is mainly active at night but can be seen in the early morning, late afternoon or on overcast days. Scats are dropped at latrines which lie within the home range (Stuart and Stuart 1988). These scat middens are oval shaped and the scats are buried after being passed (Smithers 1983). Smithers (1983) notes that this species is predominantly nocturnal and normally solitary but may be found in pairs or in family parties. They lie up in burrows made from abandoned antbear or springhaas holes during the day but are fully capable of digging their own (Smithers 1983).

Food: Stuart and Stuart (1988) write that the aardwolf eats termites and, occasionally, other insects. Termites form part of its diet all the year around (Kok and Hewitt 1990). There is some contradiction here as Bothma (1965) writes that it also eats rodents, reptiles, nestlings, eggs and carrion. Smithers (1983) concludes, after examining all available evidence that this species preys on termites, grasshoppers and insects. It would seem, therefore, that this species is not a likely accumulator of microfauna.

The Felids

Felids are unlikely accumulators of fossil microfaunal assemblages as they wreak the greatest amount of damage to the bone of all the carnivores. Andrews (1990a) notes that, due to the great amount of damage wrought on microfaunal bones by this predator, he was unable to obtain sufficient bone samples to enable him to run his analyses. Andrews and Evans (1983) note that in their study of scats from feral cats and margays in London zoo,

they found that the bones were reduced to small flakes and fragments and there was severe corrosion on bones and teeth.

AFRICAN WILD CAT (*Felis Lybica)*

Habitat and Habits: This cat has a wide habitat tolerance and occurs throughout the southern subregion, however, it does require cover (Stuart and Stuart 1988). This species is nocturnal and solitary unless the female is in oestrus (Smithers 1983). Droppings are usually buried but may accumulate at small latrine sites (Stuart and Stuart 1988). (The European wildcat (*Felis sylvestris*), unlike the domesticated cat, does not bury its scats but uses them, together with urine, to mark its territory (Lockie 1966). Kittens may be born in old burrows, dense vegetation or rock crevices (Stuart and Stuart 1988).

Food: Muridae were the most common food of *Felis lybica* and Stuart (1977) cites Smithers (1971) who wrote that muridae were the most common prey species for the above in Botswana. The incidence of plant foods in the diet is generally low (Smithers 1971). Insects are important, but in Botswana *Felis libyca* showed a preference for arachnids. In a study of scats of the Wild cat in the Karoo National Park, Coleoptera appeared to be a major part of their diet (Smithers 1983). Rodents and small mammals, birds, amphibians, reptiles insects and other invertebrates, young hyrax, rabbits and hares are all eaten (Smithers 1983; Palmer and Fairall 1988; Stuart and Stuart 1988).

A study of *Felis libyca* scats (collected from the top of a large granite boulder) made in January and in July in the same area of the Central Namib Desert showed that the percentage of mammalian remains ranged from 90-96.6%, Birds 11-14%, reptiles 0.7%, insects 72-75%, Arachnid 10% and plant material 12.2-18% (Stuart 1977). Scorpions were found in both scats (Stuart 1977).

SMALL SPOTTED CAT (*Felis nigripes)*

Habitat and Habits: This species is the smallest of the felids found in the subregion (Stuart and Stuart 1988). It is nocturnal and occurs in dry, open habitats with some vegetation cover (Stuart and Stuart 1988). During the day this cat lies in abandoned burrows and hollow termite mounds (Stuart and Stuart 1988; Smithers 1983). Little is known about these species as they are very secretive.

Food: reptile, insects birds and small rodents.

Due to their small size it is likely that the prey items of this species would be greatly fragmented during consumption.

CARACAL (*Felis caracal)*

Habitat and Habits: It is found in a variety of areas such as semi-desert, savannah woodland, coastal forests and hilly areas (Stuart and Stuart 1988). Kittens may be born in old burrows, dense vegetation or rock crevices (Stuart and Stuart 1988). In a study made by Grobler (1981) over a two year period in the Mountain Zebra National Park, caracals were observed to be active in the early morning and late afternoon, but more active at night. The Caracal is predominantly nocturnal (Smithers 1971) but partly diurnal if undisturbed (Stuart and Stuart 1988).

Of 48 mammal species known to occur in the Karoo National park, 16 were identified in caracal scats and these constituted 86% of all prey taxa identified in 112 caracal scats (Palmer and Fairall 1988). 12 scats were found to contain identifiable prey. Grey rhebuck was the most common mammal found in the scats and appeared in 23% of the scats, hyrax remains occurred in 22% of the scats and Lagomorph remains in 19 scats only..

Food: Small and medium sized mammals (up to bushbuck size) and birds and reptiles are eaten (Stuart and Stuart 1988). The Cape Grey Mongoose, monkeys and ostrich are also taken Bothma (1965). This species eats grass and grapes (Palmer and Fairall 1988).

A study was made of Caracal scats over a two year period in the Mountain Zebra National Park, Cradock, Cape Province (Grobler1981). Items eaten included; Steenbok, two juvenile Black-Backed jackals, Wild cat and Kori bustard. The Cape dassie (*Procavia capensis)* was the main food item and 53.3% of the prey taken was composed of this species. Biomass wise, however, the mountain reedbuck provided the largest contribution - 19.6% of prey taken (Grobler1981). Mammals provided 93.8% of prey, birds (such as guinea fowl and francolin) 5.3%, and

reptiles 0.9% (Grobler 1981). The stomach contents of a caracal from the Cape was found to contain 51.0% grapes and 48.1% mammals, the mammals consisting mainly of small rodents (Viljoen and Davis 1973).

Small birds were entirely consumed except for their feathers, with larger birds, the skull, legs, primaries and viscera were left (Grobler 1981). Small mammals and birds were played with before being consumed (Grobler 1981). The frontal portion of the skull, the skin, visceraand the tail and feet were left uneaten when hares and dassies were consumed (Grobler 1981).

LEOPARD (*Panthera pardus*)

Habitat and Habits: The leopard shows a wide habitat tolerance and may be found in mountains or coastal pleins, it only requires cover (Stuart and Stuart 1988). The Leopard may store surplus food among rocks, in trees or under dens bush (Stuart and Stuart 1988). Andrews (1990a) notes that this species is not a likely accumulator of small mammal bones.

Food: Insects, rodents, birds, medium and large-sized antelope. In rocky, montane areas dassies may play an significant part in the diet of the leopard (Stuart and Stuart 1988).

The Mustelidae

Smaller mustelids do not eat bone when feeding on prey larger than themselves. Bones present in scats often consist of little more than flakes and fragments and even identification of body parts can be difficult (Andrews and Evans 1983). The head is often not eaten. Digestion is seen on all the bones and the enamel on vole molars showed etching and corrosion on the enamel and in some places the dentine and cement were dissolved (Andrews and Evans 1983). Bones showed rounding on broken edges and deep corrosion on the surface of the bones. Andrews and Evans (1983) conclude that, caching behaviour aside, mustelids are not accumulators of significant amounts of microfauna.

CAPE CLAWLESS OTTER (*Aonyx capensis*)

Habitat and Habits: The Cape clawless otter is found in marshes, rivers, dry stream beds, lakes, dams and inter-tidal zones (Stuart and Stuart 1988). This species is active during early morning and late afternoon but may hunt at any time during the day or night (Stuart and Stuart 1988). Large latrines are built up, usually distinguishable by their large crab-shell component (Stuart and Stuart 1988). These latrines usually form near deep water (Smithers 1983). Whether the accumulation of latrines is to mark territory, or for reasons of hygiene is unclear (Lockie 1966). Smithers (1983) notes that the latrines that are built up are not large as scats may be deposited in one place for a few days but the otter has a large range and soon moves on.

Food: Fresh-water crabs, fish and frogs, molluscs, small mammals, birds and insects (Stuart and Stuart 1988).

HONEY BADGER (*Mellivora capensis*)

Habitat and Habits: The honey badger is found over most of Africa, excluding the northern regions (Smithers 1983). Interestingly, throughout this vast range they are nowhere common (Smithers 1983). The Honey badger is found in most habitats excluding the coastal Namib desert (Stuart and Stuart 1988). This badger is mainly nocturnal but may be active in the early morning and late afternoon in areas where it is undisturbed (Stuart and Stuart 1988).

Food: This animal eats a wide range of food but feeds mainly on insects, invertebrates, rodents. It also eats reptiles birds, other small mammals, carrion and wild fruit (Stuart and Stuart 1988).

STRIPED POLECAT (*Ictonyx striatus*)

Habitat and Habits: The Striped polecat is found throught the subregion in all major habitats, except for the Namib desert coast (Stuart and Stuart 1988). This animal is strictly nocturnal (Stuart and Stuart 1988) and usually solitary, though female-males pairs or females with young may be found. Shelter is sought in abandoned burrows, rocky outcrops, tree roots or in matted vegetation (Stuart and Stuart 1988; Smithers 1983). Andrews (1990a) notes

that in an investigation of polecat scats, the bone was so fragmented as to be unrecognizable, lack of cranial material indicated that the heads had not been eaten.

Food: Mainly insects, small animals and rodents (Stuart and Stuart 1988). In an examination of the stomach contents of a striped polecat from the Kalahari Gemsbok National park it was found that reptiles such as lizards constituted the bulk of food eaten (Stuart and Stuart 1988). Smithers (1983) notes that the main food of this species is mice and insects but birds, reptiles, spiders and amphibia, scorpions, centipedes and millipedes are also eaten (Smithers 1983). The polecat kills rats and mice by biting them all over the body until they are immobilised at which time they are killed by a bit to the neck.

Appendix 4

The following tables record Andrews (1990a) results for his analyses done on the various predator assemblages (see text for further details).

Table 1: Cranial breakage in the predator assemblages

Maxillae ** Skulls are termed complete if they have the maxillary, zygomatic and frontal bones intact and disregarding damage or loss of the parietal, occipital and basal regions			Mandibles		
Predator	% complete** maxillae	% maxillae with zygomatic	% complete mandibles	% ramus missing	% inferior border broken/missing
Barn owl	75	90	78	6	3
Snowy owl	80	80	58	5	21
Long-eared owl	74	94	81	2	2
Short-eared owl	24	24	24	38	10
Verreaux eagle owl	85	94	84	6	3
Spotted eagle owl	17	48	7	62	27
European eagle owl	27	64	38	18	14
Great grey owl	83	83	89	0	7
Tawny owl	64	69	19	18	14
Little owl	0	0	0	33	50
Kestrel	5	19	4	71	44
Hen harrier	9	30	2	55	69
Mongoose	0	10	0	95	100
Genet	0	24	0	94	75
Bat-eared fox	0	10	0	95	86
Coyote	0	12	0	100	75
Red fox	0	0	0	75	100
Artic fox	0	0	0	100	100
Pine marten	0	0	0	100	100

(After Andrews 1990a: Table 3.7 & Table 3.5)

Table 2: Tooth loss from the maxilla and mandibles

Predator	Mandibles		Maxillae	
	% molar loss	% incisor loss	% molar loss	% incisor loss
Barn owl	34	3	27	26
Snowy owl	12	5	42	20
Long-eared owl	21	1	17	28
Short-eared owl	35	7	77	82
Verraux eagle owl	51	15	66	36
Spotted eagle owl	32	14	43	87
European eagle owl	32	6	38	72
Great grey owl	40	7	51	57
Tawny owl	16	14	21	50
Little owl	39	33	75	100
Kestrel	42	44	52	94
Hen harrier	48	66	40	98
Mongoose	60	100	54	86
Genet	45	72	38	100
Bat-eared fox	67	68	87	70
Coyote	72	50	69	69
Red fox	58	75	67	100
Artic fox	60	20	67	100
Pine marten	72	33	92	100

(After Andrews 1990a: Table 3.6 and Table 3.8)

Table 3: The percentage of isolated molars and incisors in the predator assemblages

Predator	% isolated molars	% isolated incisors
Barn owl	96	56
Snowy owl	92	200
Long-eared owl	71	83
Short-eared owl	49	139
Verreaux eagle owl	61	65
Spotted eagle owl	34	90
European eagle owl	70	102
Great grey owl	57	113
Tawny owl	35	128
Little owl	156	116
Kestrel	139	159
Hen harrier	64	88
Mongoose	79	114
Genet	65	150
Bat-eared fox	13	132
Coyote	36	114
Red fox	75	225
Artic fox	43	43
Pine marten	46	150

(After Andrews 1990a: Table 3.9)

Table 4: Breakage of *in situ* and isolated molars and mandibles

	MOLARS			INCISORS		
	% in situ molars broken	% isolated molars broken	% all molars broken	% in situ incisors broken	% total isolated incisors broken	% total incisors brok/tot incis in package broken
Predator	(maxillae & mandibles)			(maxillae & mandibles		
Barn owl	0	0	0	0	0	0
Snowy owl	0	0	0	0	0	0
Long-eared owl	0	0	0	0	0	0
Short-eared owl	0	0	0	0	13	5
Verreaux eagle owl	1.4	1.3	1	5.3	14.7	7
Spotted eagle owl	.5	*	*	3.7	6.7	5
European eagle owl	1.8	2.9	2	4.7	7.5	6
Great grey owl	0	1.3	0	0	0	0
Tawny owl	1.7	16.3	3	2	15.6	7
Little owl	0	24	15	0	42.9	27
Kestrel	9	16	13	9.9	11.7	11
Hen harrier	2.7	15.8	7	0	12.5	10
Mongoose	17	20	19	-	88.1	88
Genet	1.6	0.8	1	20.5	48.2	44
Bat-eared fox	24.2	44.4	29	28.5	57.5	53
Coyote	8	76.2	39	37.5	31.3	33
Red fox	0	83.3	43	-	80	80
Artic fox	41.7	77.8	57	50	100	71
Pine marten	16.6	90.9	65	33.3	77.8	67

(After Andrews (1990):Table 3.10 and Table 3.11)

Table 5: Relative proportions of postcranial to cranial elements

Species	No. of Pellet samples	Proportion of postcranial to cranial elements femur + humerus / mandible + maxilla (1)	Proportion of distal limb elements tibia +radius / femur and humerus (2)
Barn owl	4	93	105
Snowy owl	1	133	98
Long-eared owl	2	102	92
Short-eared owl	1	111	82
Verreaux eagle owl	3	80	100
Spotted eagle owl	1	74	52
European eagle owl	2	111	75
Great grey owl	1	92	89
Tawny owl	3	82	92
Little owl	1	164	70
Kestrel	3	74	72
Hen harrier	1	37	58
Mongoose	1	138	30
Genet	1	76	44
Bat-eared fox	1	92	25
Coyote	1	133	79
Red fox	1	233	50
Artic fox	1	36	75
Pine marten	1	114	25

(After Andrews 1990a: Table 3.2)

Table 6: The breakage patterns of the major long bones (%)

	Humerus				Ulna				Femur				Tibia			
Predator	**C**	**P**	**S**	**D**	**C**	**P**	**S**	**D**	**C**	**P**	**S**	**D**	**C**	**P**	**S**	**D**
Barn owl	99	0	0	1	97	3	0	0	97	1	2	0	98	1	1	0
Snowy owl	75	4	8	12	76	24	0	0	88	4	0	8	88	8	4	0
Long eared owl	96	0	1	3	95	4	1	0	96	3	1	0	93	6	1	0
Short eared owl	88	3	2	7	92	8	0	0	93	7	0	0	87	4	5	4
Verreaux eagle owl	96	0	2	2	98	2	0	0	97	2	1	0	99	1	0	0
Spotted eagle. owl	44	7	11	38	85	12	3	0	66	32	2	0	71	0	29	0
European eagle owl	82	7	0	11	97	3	0	0	83	12	3	2	86	9	0	5
Great grey owl	89	4	4	4	96	4	0	0	90	8	2	0	93	7	0	0
Tawny owl	53	7	12	28	69	31	0	0	52	22	6	20	85	7	4	4
Little owl	33	33	16	16	100	0	0	0	12	64	12	12	33	8	50	8
Hen harrier	22	7	39	32	60	40	0	0	20	40	20	20	22	22	33	22
Kestrel	44	4	27	25	32	52	8	8	20	48	24	7	31	29	25	14
White tailed mongoose	30	29	9	32	8	92	0	0	12	52	13	23	37	25	38	-
Small spotted.genet	33	13	10	44	54	46	0	0	12	51	20	17	57	27	16	-
Bat eared fox	26	7	15	52	57	43	0	0	3	87	3	7	10	80	10	-
Coyote	7	38	17	38	25	75	0	0	0	42	28	30	0	90	10	-
Red fox	0	8	9	83	0	67	33	0	0	53	21	26	0	67	33	-
Pine marten	0	30	19	51	25	75	0	0	0	50	50	0	0	82	18	-

(After Andrews 1990a: Table 3.3)

Key: C = complete, P = proximal, S = Shaft, D = Distal

Appendix 5

The micromammal bones (cranial and postcranial) from Elands Bay Cave

The spreadsheets in this appendix list the micromammal bones found in the various units in Elands Bay Cave. The units are listed in alphabetic order from A to Z.

ACRONYM	SQUARE	NO	FEMUR COMPLETE	FEMUR SHAFT	FEMUR PROXIMAL	FEMUR DISTAL	TIBIA COMPLETE	TIBIA SHAFT	TIBIA PROXIMAL	TIBIA DISTAL	HUMERUS COMPLETE	HUMERUS SHAFT	HUMERUS PROXIMAL	HUMERUS DISTAL	RADIUS COMPLETE	RADIUS PROXIMAL	ULNA COMPLETE	ULNA PROXIMAL	CRANIAL FRAGMENT	MANDIBLE	MANDIBLE FRAGMENT	PREMAXILLA	PREMAXILLA FRAGMENT	MAXILLA	DAMAGE CATEGORY	SINGLE INCISORS	INCISOR FRAGMENT	SINGLE MOLARS	VERTEBRA	1/2-3/4 VERTEBRA	COMPLETE INNOMINATE	PORTION OF INNOMINATE	CLAVICLE	SCAPULA	SCAPULA FRAGMENT	METAPODIAL	CALCANEUM & ASTRAGALUS	COMMENTS
ABRU	D	8																										1										
ABRU	D	8								1																												
ABRU	D	6																						1	1													
ACHE	Y	7												1																								
ACHE	Y	7																									2											
ACHE	Y	7			1																																	
ACHE	Y	7																						1	2													
ACHE	Y	7																											2									
ACHE	Y	7			1																																	
ACHE	Y	7																		1					3,4													
ACHE	Y	7																						1	1													
ALAB	A	8																											1									
ALAB	B	6								1																												
ALAB	B	6	1																																			
ALAC	X	6																		1					1													
ALAC	Z	6																		1					0													
ALAG	E	9																								1												
ALAG	E	9																				1																
ALBC	BE/AB														1																							
ALBC	BE/AB																			1					1													
ALBC	X	6								1									1																			
ALBC	X	6																				1																L & R PREMAX & MAX JOINED, SHREW
ALBC	X	6																				1																
ALBC	X	6																						1	0													L & R PREMAX & MAX JOINED, SHREW
ALBC	X	6																		1					2													
ALBC	X	6																								1												
ALBC	X	6																				1																L & R PREMAX & MAX JOINED, SHREW
ALBC	X	6																						1	0													L & R PREMAX & MAX JOINED, SHREW
ALBC	Y	6																																		18		
ALBC	Y	6																																1				
ALBC	Y	6																																		1		
ALBC	Y	6																1																				
ALBC	Y	6																											2									
ALBC	Z	6																														1						
ALBC	Z	6																		1					4													
ALBC	Z	6																										1										
ALGL	A	7					1																															
AMIN	A	3																		1					3													
AMIN	A	4			1																																	
AMIN	A	4			1																																	
AMIN	A	4																		1					0													
AMIN	B	1							1																													
AMIN	B	2																								1												
AMIN	B	2																		1					2													
AMIN	Z	1									1																											
AMIX	Z	2																											1									
AMIN	Z	3								1																												
APOL	A	2	1																																			
APOL	A	2									1																											
ARST	Z	8																				1																L & R PREMAX & MAX JOINED, SHREW
ARST	Z	8								1																												
ARST	Z	8			1																																	
ARST	Z	8																													1							
ARST	Z	8																						1	0													L & R PREMAX & MAX JOINED, SHREW
ARST	Z	8	1																																			
ARST	Z	8																														1						
ARST	Z	8																			71								1									
ARST	Z	8																											1									
ARST	Z	8																	2																			
ARST	Z	8																				1																L & R PREMAX & MAX JOINED, SHREW
ARST	Z	8																						1	0													L & R PREMAX & MAX JOINED, SHREW
ARST	Z	8							1																													
ARST	Z	8																						1	1													
ARST	Z	8																														1						
ASHE	A	2			1																																	
ASHE	A	4												1																								GOLDEN MOLE
ASHE	A	4																														1						
ASHE	B	2										1																										
ASHE	B	3			1																																	
ASHE	B	3																								1												
ASHE	B	3																		1					1													
ASHE	B	4			1																																	
ASHE	B	4																		1					3													SHREW
ASHE	B	4																											2									
ASHE	B	4																		1					1													
ASHE	B	4																														1						
ASHE	B	4																		1					1													
ASHE	B	4					1																															
ASHE	B	5													1					1					3													
ASHE	X	2																																				
ASHE	X	2			1																																	
ASHE	X	4																		1					1													
ASHE	Y	2	1																																			
ASHE	Y	3																																		1		

			FEMUR	FEMUR	FEMUR	FEMUR	TIBIA	TIBIA	TIBIA	TIBIA	HUMERUS	HUMERUS	HUMERUS	HUMERUS	RADIUS	RADIUS	ULNA	ULNA	CRANIAL	MANDIBLE	MANDIBLE	PREMAXILLA	PREMAXILLA	MAXILLA	DAMAGE	SINGLE	INCISIOR	SINGLE	VERTEBRA	1/2-3/4	COMPLETE	PORTION OF	CLAVICLE	SCAPULA	SCAPULA	METAPODIAL	CALCANEUM &	
ACRONYM	SQUARE	NO	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	PROXIMAL	COMPLETE	PROXIMAL	FRAGMENT		FRAGMENT		FRAGMENT		CATEGORY	INSCISORS	FRAGMENT	MOLARS		VERTEBRA	INNOMINATE	INNOMINATE			FRAGMENT		ASTRAGALUS	COMMENTS
ASHE	Y	3																																			1	
ASHE	Y	3																						1	1														
ASHE	Y	4											1																										
ASHE	Y	4																										1										
ASHE	Z	3			1																																	
ASHE	Z	4																		1					1													
ASHE	Z	4																														1						
ASHE	Z	4	1																																			
ASHE	Z	4																														1						
ASHE	Z	4																										2										
ASHL	D	8																								1												
ASHL	B	8																								1												
ATLA	B	6																			71				4													
ATLA	B	6																		1					8													
ATLA	B	6																						1	2													
ATLA	B	6																1																				
ATLA	B	6																										3										
ATLA	B	6																									1											
ATLA	B	6																		1					8													
ATLA	B	6																								2												
ATLA	B	6																																		1			
ATLA	B	6																																					
ATLA	B	6																				1																	
ATLA	B	6																		1					1													
ATLA	B	6																										1										
BAAD	X	3								1																						1						
BAAD	X	3																																					
BAAD	X	3								1																													
BAAD	X	3																												3								
BAAD	X	3																										6										
BAAD	X	3																																		1		
BAAD	X	4			1																																	
BAAD	X	4																										1										
BAAD	X	4																		1					1													
BAAD	X	4															1																					
BAAD	Y	3												1																									
BAAD	Y	4																														1						
BAAD	Y	4									1																												
BAAD	Y	4																						1	1													
BAAD	Y	4									1																												
BAAD	Y	4					1																																
BAAD	Z	4												1																									
BAAD	Z	4																								1												
BACR																										1												
BACR																				1					8													
BACR																				1					1													
BACR																						1																
BACR																											1											
BACR																								1	2													
BACR																				1							1											
BACR																									3													
BACR																								1	3													
BACR																												3										
BACR	Y	6																	1																			
BACR	Y	6																						1	1													
BACR	Y	6																1																				
BACR	Y	6																														1						
BACR	Y	6																1																				
BACR	Y	6													1																								
BACR	Y	6																		1					1.4													
BACR	Y	6																														1						
BACR	Y	6																																		2		
BACR	Y	6																		1					1													
BACR	Y	6																	1																			
BACR	Y	6																				1																
BACR	Y	6																														1						
BACR	Y	6																										1										
BADI	D	6																	7																			
BADI	D	6															1																					
BADI	D	6																														1						
BADI	D	6																						1	2													
BADI	D	6																														1						
BADI	D	6																								1												
BADI	D	6																										3										
BADI	D	6																						1	2													
BADI	D	6																																		1		
BADI	D	6															1																					
BADI	D	6																									1											
BADI	D	6															1																					
BADI	D	6				1																										1						
BADI	D	6																														1						
BADI	D	6																																				
BADI	D	6																										1										
BARR	X	4																												2								
BARR	C	4																								1												
BARR	C	4																		1					3.4													

APPENDIX 5

ACRONYM	SQUARE	NO	FEMUR COMPLETE	FEMUR SHAFT	FEMUR PROXIMAL	FEMUR DISTAL	TIBIA COMPLETE	TIBIA SHAFT	TIBIA PROXIMAL	TIBIA DISTAL	HUMERUS COMPLETE	HUMERUS SHAFT	HUMERUS PROXIMAL	HUMERUS DISTAL	RADIUS COMPLETE	RADIUS PROXIMAL	ULNA COMPLETE	ULNA PROXIMAL	CRANIAL FRAGMENT	MANDIBLE	MANDIBLE FRAGMENT	PREMAXILLA	PREMAXILLA FRAGMENT	MAXILLA	DAMAGE CATEGORY	SINGLE INCISORS	INCISOR FRAGMENT	SINGLE MOLARS	VERTEBRA	1/2-3/4 VERTEBRA	COMPLETE INNOMINATE	PORTION OF INNOMINATE	CLAVICLE	SCAPULA	SCAPULA FRAGMENT	METAPODIAL	CALCANEUM & ASTRAGALUS	COMMENTS
BARI	C	4																		1					1														
BARI	C	4																		1					1														
BARI	C	4																								2													
BARI	C	4																		1					3														
BARI	C	4																														1							
BARI	C	4																						1	3														
BARH	E	9																				1																	
BARH	E	9																		1					2														
BARH	E	9																				1																	
BARH	E	9					1																																
BARH	E	9												1																									
BARH	E	9								1														1	1														
BARH	E	9																									2												
BARH	E	9																					71			3													
BARH	E	9																				1																	
BARH	E	9			1																																		
BARH	E	9			1																																		
BARH	E	9																1																					
BARH	E	9																				1																	
BARH	E	9									1																													
BARH	E	9															1																						
BARH	F	10				1																																	
BARH	F	10																																					
BARH	F	10																											1										
BARR																				1					1														
BARR	C	3									1																													
BARR	C	4			1																																		
BARR	C	6																						1	2														
BARR	C	6				1																																	
BARR	C	6																											1										
BARR	C	6																											1										
BARR	C	6																1																					
BARR	C	6																															1						
BASR	X	6																						1	1														
BASR	X	6																		1					1														
BASR	Y	4																		1					3														
BASR	Y	4												1																									
BASR	Y	4																						1	3														
BASR	Z	6			1																																		
BASR	Z	6																		1					1														
BE	D	6																								1													
BE	D	6				1																																	
BEDP	B	8																		1					8														
BEDP	C	8																											4										
BEDP	C	9			1																																		
BEDP	C	9																														1							
BEDP	C	9			1																			1	2														
BEDP	C	9																		1					8														SHARK
BEDP	C	9												1																									
BEDP	C	9											1																										
BEDP	C	9																								4													
BEDP	C	9																						1	1														
BEDP	C	9																						1	1														
BEDP	E	9																											8										
BEDP	Z	6																		1					1														
BEFO	X	4																		1					1														
BEFO	X	4																				1																	L & R PREMAX JOINED
BEFO	X	4																		1					2														
BEFO	X	4									1															2														
BEFO	X	4																														1							
BEFO	X	4																				1																	
BEFO	X	4																									2												
BEFO	X	4		1																		1			1														
BEFO	X	4																				1																	L & R PREMAX JOINED
BEFO	X	4																																1					
BEFO	X	4																						1	1														
BEFO	X	4																																					JOINED TO 1/2 MAX
BEFO	X	4																						1	2														
BEFO	X	4																				1																	
BEFO	X	4																						1	3														
BEFO	X	4																				1																	
BEFO	X	4																		1					1														
BEFO	X	4																				1																	
BEFO	X	4																										1											
BEFO	X	4			1																	1			1														
BEFO	X	4																				1																	

ACRONYM	SQUARE	NO	FEMUR COMPLETE	FEMUR SHAFT	FEMUR PROXIMAL	FEMUR DISTAL	TIBIA COMPLETE	TIBIA SHAFT	TIBIA PROXIMAL	TIBIA DISTAL	HUMERUS COMPLETE	HUMERUS SHAFT	HUMERUS PROXIMAL	HUMERUS DISTAL	RADIUS COMPLETE	RADIUS PROXIMAL	ULNA COMPLETE	ULNA PROXIMAL	CRANIAL FRAGMENT	MANDIBLE	MANDIBLE FRAGMENT	PREMAXILLA	PREMAXILLA FRAGMENT	MAXILLA	DAMAGE CATEGORY	SINGLE INCISORS	INCISOR FRAGMENT	SINGLE MOLARS	VERTEBRA	1/2-3/4 VERTEBRA	COMPLETE INNOMINATE	PORTION OF INNOMINATE	CLAVICLE	SCAPULA	SCAPULA FRAGMENT	METAPODIAL	CALCANEUM & ASTRAGALUS	COMMENTS
BEFO	X	6							1																													
BEFO	X	6								1																												
BEFO	X	6																		1					2												
BEFO	X	6																				1															
BEFO	X	6																		1					8												
BEFO	X	6																		1					1												
BEFO	X	6																		1					8												
BEFO	X	6																						1	1												
BEFO	X	6																								1											
BEFO	X	6																									1										
BEFO	Y	4							1																												
BEFO	Y	4			1																																
BEFO	Y	4																					1														
BEFO	Y	4						1																													
BENE	X	2											1																								
BENE	X	2																									1										
BENE	X	2	1																																		
BENE	X	2																		1					1												
BENE	Y	2																		1					2												
BENE	Y	2																														1					
BENE	Y	2																		1					1												
BENE	Z	3			1																																
BENE	Z	4																										1									
BENE	Z	4																		1					1												
BERO	A	6																		1					1												
BERO	A	6									1																										
BERO	A	6																1																			
BERO	B	6							1																												
BERO	B	6											1																								
BERO	B	6											1																								
BERO	Z	4																						1	2												
BETT	A	8							1																												
BETT	A	8											1																								
BETT	A	8	1																																		
BETT	A	8																											2								
BETT	A	8	1																																		
BETT	A	8																						1	1												
BETT	A	8					1																														
BETT	A	8									1																										
BETT	B	8																		1					3												
BOBS	X	3																						1	2												
BOBS	X	3																						1	2												
BOBS	Y	3							1																												
BOBS	Y	3																		1					2												
BOBS	Y	3																												1							
BOBS	Y	3																																	2		
BING	C	7																		1					1												
BLEN	Z	3									1																										
BLEN	Z	3																														1					
BLEN	Z	3																		1					1												
BLEN	Z	3					1																														
BLEN	Z	3																		1					1												
BLEN	Z	3																1																			
BLEN	Z	3																		1					8												
BLEN	Z	3																		1					8												
BLEN	Z	3																																			
BNEF	Z	4																											1								
BOBM	C	7	1																																		
BOBM	C	7																		1					8												
BOBM	C	7																		1					2												
BOBM	C	7									1																										
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BOBM	C	7	1																																		
BOBM	C	7																		1					2												
BOBM	C	7																								1											
BOBM	C	7																		1					4												
BOBM	C	7																		1					0												
BOBM	C	7			1																																
BOBM	C	7	1																																		
BOBM	C	7																						1	1												
BOBM	C	7																		1					2												
BOBM	C	7																									1										
BOMM	Y	8																											2								
BOMM	Y	8																				1															
BOMM	Y	8			1																																
BOMM	Y	8																						1	2												
BOMM	Y	8																								1											
BRNE	A	3																		1					2												
BRNE	A	3																														1					
BRNE	A	3																						1	1												
BRNE	Y	3	1																																		
BRNE	Y	3																		2					3												SHRW
BRNE	Y	3																										2									
BRNE	Z	2																		1					2												
BRNE	Z	3																						1	2												
BRNE	Z	3											1																								
BRNE	Z	3											1																								

			FEMUR	FEMUR	FEMUR	FEMUR	TIBIA	TIBIA	TIBIA	TIBIA	HUMERUS	HUMERUS	HUMERUS	HUMERUS	RADIUS	RADIUS	ULNA	ULNA	CRANIAL	MANDIBLE	MANDIBLE	PREMAXILLA	PREMAXILLA	MAXILLA	DAMAGE	SINGLE	SINGLE	SINGLE	VERTEBRA	1/2-3/4	COMPLETE	PORTION OF	CLAVICLE	SCAPULA	SCAPULA	METAPODIAL	CALCANEUM &	
ACRONYM	SQUARE	NO	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	PROXIMAL	COMPLETE	PROXIMAL	FRAGMENT		FRAGMENT		FRAGMENT		CATEGORY	INCISORS	FRAGMENT	MOLARS		VERTEBRA	INNOMINATE	INNOMINATE			FRAGMENT		ASTRAGALUS	COMMENTS
BRKE	Z	3											1															1				1							
BRKE	Z	2																										1											
BRKE	Z	2							1																														
BRKE	Z	2											1																										
BRKE	Z	2															1																						
BRKE	Z	3											1																										
BRKH	X	4																		1					2														
BRSS					1																																	1		
BRSE																																								
BRSS	C	3																												1									
BRSS	C	3																														1							
BRSE	D	3																														1							
BRSE	D	6			1																																		
BRST	C	9																		1					1														
BRST	C	9																		1					1														
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BRST	C	9																		1					4.1														
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BRST	C	9																		1					1														
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BRST	C	9																						1	1														
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BRST	C	9			2																																		
BRST	C	9																								3													
BRST	D	9																		1					1														
BRST	D	10																																				1	
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BRST	F	9																1																					
BRUE	A	6			1																																		
BRUE	A	6																		1					2														
BRUE	A	5				1																																	
BRUE	A	7																						1	2														
BRUE	A	7					1																																
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BRUE	A	7																						1	2														
BRUE	A	7	1																																				
BRUE	A	7			1																																		
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BRUE	B	7																		1					4.1														
BRUE	B	7								1																													
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BRUE	B	6																															1						
BRUE	B	5			1																																		
BRUE	Z	6				1																																	
BRUEBRUE	B	7								1																													
BSAH	A	5																										1											
BSAH	A	5																										1											
BSAH	A	6																		1					3														
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BSAH	A	6																		1					1														
BSAH	A	6																							3														
BSBP																											1												

			FEMUR	FEMUR	FEMUR	FEMUR	TIBIA	TIBIA	TIBIA	TIBIA	HUMERUS	HUMERUS	HUMERUS	HUMERUS	RADIUS	RADIUS	ULNA	ULNA	CRANIAL	MANDIBLE	MANDIBLE	PREMAXILLA	PREMAXILLA	MAXILLA	DAMAGE	SINGLE	INCISOR	SINGLE	VERTEBRA	1/2-3/4	COMPLETE	PORTION OF	CLAVICLE	SCAPULA	SCAPULA	METAPODIAL	CALCANEUM &	
ACRONYM	SQUARE	NO	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	PROXIMAL	COMPLETE	PROXIMAL	FRAGMENT		FRAGMENT		FRAGMENT		CATEGORY	INCISORS	FRAGMENT	MOLARS		VERTEBRA	INNOMINATE	INNOMINATE			FRAGMENT		ASTRAGALUS	COMMENTS
BSBP																				1					8													
BSBP	5/91																			1					1													
BSBP	5/91																							1	2													
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BSBP	C	4																						1	1													
BSBP	C	6			1																																	
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BSBP	C	6																		1					2													
BSBP	C	8								1																												
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BSBP	D	3																												1								
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BSBP	D	8																		1					1													
BSBP	E	3							1																													
BSBP	E	3																					71															
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BSBP	E	3																				1																
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BSBP	E	4																								2												
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BSBP	E	4																		1					1													
BSBP	E	4																					1															
BSBP	E	4																				1																
BSBP	E	4																		1					4													new
BSBP	E	4																						1	2													
BSBP	E	4																		1					1													
BSBP	E	4			1																																	

ACRONYM	SQUARE	NO	FEMUR COMPLETE	FEMUR SHAFT	FEMUR PROXIMAL	FEMUR DISTAL	TIBIA COMPLETE	TIBIA SHAFT	TIBIA PROXIMAL	TIBIA DISTAL	HUMERUS COMPLETE	HUMERUS SHAFT	HUMERUS PROXIMAL	HUMERUS DISTAL	RADIUS COMPLETE	RADIUS PROXIMAL	ULNA COMPLETE	ULNA PROXIMAL	CRANIAL FRAGMENT	MANDIBLE	MANDIBLE FRAGMENT	PREMAXILLA	PREMAXILLA FRAGMENT	MAXILLA	DAMAGE CATEGORY	SINGLE INSCISORS	INSCISOR FRAGMENT	SINGLE MOLARS	VERTEBRA	1/2-3/4 VERTEBRA	COMPLETE INNOMINATE	PORTION OF INNOMINATE	CLAVICLE	SCAPULA	SCAPULA FRAGMENT	METAPODIAL	CALCANEUM & ASTRAGALUS	COMMENTS
BSBP	E	4																								1												
BSBP	E	4																		1					1													
BSBP	E	4																																1				
BSBP	E	4							1																													
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BSBP	E	4								1																												
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BSBP	E	4																		1					1													
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BSBP	E	4																		1					4,3													
BSBP	E	4																		1					2,4													
BSBP	E	4																						1	2													
BSBP	E	4																		1					1													
BSBP	E	5																								1												
BSBP	E	6																		1					2													
BSBP	E	5												1																								
BSBP	E	6									1																											
BSBP	E	6	1																																			
BSBP	E	8																		1					1													
BSBP	F	3							1																													
BSBP	F	3																								1												
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BSBP	F	3																										1										
BSBP	F	4																		1					1													
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BSBP	F	4												1																								
BSBP	F	4																		1					2													
BSBP	F	4												1																								
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BSBP	F	4																		1					1													
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BSBP	F	4																											1									
BSBP	F	4																											1									
BSBP	F	4	1																																			
BSBP	F	4																		1					4,2													ELEPHANT SHREW
BSBP	F	4																						1	2													
BSBP	F	4																				1																
BSBP	F	4																											1									
BSBP	F	4																						1	2													
BSBP	F	4					1																															
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BSBP	F	4																						1	1													
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BSBP	F	4	1																																			
BSBP	F	4																						1	2													
BSBP	F	4			1																																	
BSBP	F	4																										2										
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BSBP	F	4																				1																
BSBP	F	4																		1					8													
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BSBP	F	4																		1					1													
BSBP	F	4																										1										
BSBP	F	4							1																													
BSBP	G	3									1																											
BSBP	G	3							1																													
BSBP	G	4																						1	3													ELEPHANT SHREW
BSBP	G	4																						1	1													ELEPHANT SHREW
BSJF	E	10																								10												
BSJF	E	10											1																									
BSJF	E	10			1																																	
BSJF	E	10				1																																
BSJF	E	10																		1					4													
BSJF	E	10																		1					1													ELEPHANT SHREW
BSJF	E	10																																			1	
BSJF	E	10																																		1		
BSJF	E	10																		1					4													
BSJF	E	10																											16									
BSJF	E	10				1																																

			FEMUR	FEMUR	FEMUR	FEMUR	TIBIA	TIBIA	TIBIA	TIBIA	HUMERUS	HUMERUS	HUMERUS	HUMERUS	RADIUS	RADIUS	ULNA	ULNA	CRANIAL	MANDIBLE	MANDIBLE	PREMAXILLA	PREMAXILLA	MAXILLA	DAMAGE	SINGLE	INCISIOR	SINGLE	VERTEBRA	1/2-3/4	COMPLETE	PORTION OF	CLAVICLE	SCAPULA	SCAPULA	METAPODIAL	CALCANEUM &	
ACRONYM	SQUARE	NO	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	PROXIMAL	COMPLETE	PROXIMAL	FRAGMENT		FRAGMENT		FRAGMENT		CATEGORY	INSCISORS	FRAGMENT	MOLARS		VERTEBRA	INNOMINATE	INNOMINATE			FRAGMENT		ASTRAGALUS	COMMENTS
BSP1	D	6																	1																			
BSP1	D	6																				1																
BSP1	D	6			1																																
BSP1	D	6																								1											
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BSP1	D	6																														1					
BSP1	D	6																				1															
BSP1	E	6	1																																		
BSP1	E	6																					1	1													
BSP1	E	6																																1			
BSP1	E	6																1																			
BSP2																											1										
BSP2																				1																	
BSP2																										1											
BSP2	6/91																			1						1											
BSP2	6/91																			1						2											
BSP2	6/91																					1															
BSP2	C	2																1																			
BSP2	C	3	1																																		
BSP2	C	3																														1					
BSP2	C	3									1																										
BSP2	C	4																										1									
BSP2	C	4						1																													
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BSP2	C	6									1																										
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BSP2	C	6																														1					
BSP2	C	6																		1						0											
BSP2	D	6							1																												
BSP2	D	6																														1					
BSP2	D	6							1																												
BSP2	D	6	1																																		
BSP2	E	6								1																											
BSP2	E	6																														1					
BSP2	F	2												1																							
BSP2	F	6																					1	2													
BSP2	F	6							1																												
BUBB	A	1																		1						1											
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BUBB	B	6																														1					
BUBB	B	1																		1						4,1											
BUBB	B	1																		1						1											
BUBB	B	1																										1									
BURN	7	7						1																													
BURN	7B	7U																									2										
BURN	7B	7U																		1						1											
BURN	7B	7U																																		2	
BURN	7B	7U				1																															
BURN	7B	7U																		1						1											
BURN	A	2				1																															
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BURN	A	3																		1						4											
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BURN	A	4																																			
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ACRONYM	SQUARE	ND	FEMUR COMPLETE	FEMUR SHAFT	FEMUR PROXIMAL	FEMUR DISTAL	TIBIA COMPLETE	TIBIA SHAFT	TIBIA PROXIMAL	TIBIA DISTAL	HUMERUS COMPLETE	HUMERUS SHAFT	HUMERUS PROXIMAL	HUMERUS DISTAL	RADIUS COMPLETE	RADIUS PROXIMAL	ULNA COMPLETE	ULNA PROXIMAL	CRANIAL FRAGMENT	MANDIBLE	MANDIBLE FRAGMENT	PREMAXILLA	PREMAXILLA FRAGMENT	MAXILLA	DAMAGE CATEGORY	SINGLE INCISORS	INCISOR FRAGMENT	SINGLE MOLARS	VERTEBRA	1/2-3/4 VERTEBRA	COMPLETE INNOMINATE	PORTION OF INNOMINATE	CLAVICLE	SCAPULA	SCAPULA FRAGMENT	METAPODIAL	CALCANEUM & ASTRAGALUS	COMMENTS
BSJF	E	10								1																												
BSJF	E	10																						1	3													
BSJF	E	10											1																									
BSJF	E	10																						1	2													
BSJF	E	10												1																								
BSJF	E	10																														1						
BSJF	E	10			1																			71	3													
BSJF	E	10																						1	1													
BSJF	E	10																											8									
BSJF	E	10			1																																	
BSJF	E	10					1																															
BSJF	E	10								1																												
BSJF	E	10												1										1	2													
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BSJF	E	10																			71				3													
BSJF	E	10														1																						
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BSJF	E	10																															1					
BSJF	E	10	2																																			
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BSJF	E	10			1																																	
BSJF	F	10			1																																	
BSJF	F	10																						1	2													
BSJF	F	10				1																																
BSJF	F	10																		1					4													0-WRW
BSJF	F	10																												1								
BSJF	F	10											1																									
BSJF	F	10																															1					
BSJF	F	10									1																											
BSO1	D	8																		1					1													
BSO2	D	6									1																											
BSO3	C	8																																				
BSO3	D	8									1																											
BSP1																																						
BSP1																							1															
BSP1																						1																
BSP1																				1					4,1													
BSP1		8												1																									
BSP1	5/91																			1					8													
BSP1	5/91																			1					2													
BSP1	5/91																			1					1													
BSP1	5/91																			1					3													
BSP1	5/91																							1	1													
BSP1	5/91																			1					1													
BSP1	5/91																			1					3,4													
BSP1	5/91																			1					2													
BSP1	5/91																			1					1													
BSP1	5/91																			1					2													
BSP1	5/91																			1					1													
BSP1	5/91																										1											
BSP1	5/91																			1					1													
BSP1	5/91																			1					1													
BSP1	5/91																											2									
BSP1	C	2																															1					
BSP1	C	3																		1					2													
BSP1	C	2																						1	2													
BSP1	C	4																		1					1													
BSP1	C	4			1																																	
BSP1	C	4																		1					1													
BSP1	C	4					1																				1											
BSP1	C	4																		1					2													
BSP1	C	4																		1					2													
BSP1	C	4																		1					1													
BSP1	C	4																		1					1													
BSP1	C	5																						1	1													
BSP1	C	5																										1										
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BSP1	C	5																		1					1													
BSP1	C	5																								3												
BSP1	C	6	1																																			
BSP1	C	6	1																																			
BSP1	C	6						1																														
BSP1	C	6					1																															
BSP1	C	6																						1	2													
BSP1	D	6																						1	2													
BSP1	D	6																												1								
BSP1	D	6								1																												

ACRONYM	SQUARE	NO	FEMUR COMPLETE	FEMUR SHAFT	FEMUR PROXIMAL	FEMUR DISTAL	TIBIA COMPLETE	TIBIA SHAFT	TIBIA PROXIMAL	TIBIA DISTAL	HUMERUS COMPLETE	HUMERUS SHAFT	HUMERUS PROXIMAL	HUMERUS DISTAL	RADIUS COMPLETE	RADIUS PROXIMAL	ULNA COMPLETE	ULNA PROXIMAL	CRANIAL FRAGMENT	MANDIBLE	MANDIBLE FRAGMENT	PREMAXILLA	PREMAXILLA FRAGMENT	MAXILLA	DAMAGE CATEGORY	SINGLE INCISORS	INCISOR FRAGMENT	SINGLE MOLARS	VERTEBRA	1/2-3/4 VERTEBRA	COMPLETE INNOMINATE	PORTION OF INNOMINATE	CLAVICLE	SCAPULA	SCAPULA FRAGMENT	METAPODIAL	CALCANEUM & ASTRAGALUS	COMMENTS
BURH	B	6																		1					1														
BURH	B	6								1																													
BURH	B	6																		1					1														
BURH	B	6																				1					1												
BURH	B	6				1																																
BURH	B	6	1																																			
BURH	B	6								1																													
BURH	B	6																		1					2														
BURH	B	6																								2												
BURH	B	6																														1						
BURH	B	6																		1					1														
BURH	B	6																		1					1														
BURH	B	6																		1					2														
BURH	B	6																		1					3														
BURH	B	6																						1	2														
BURH	B	6																		1					1														
BURH	B	6																				1																	
BURH	B	6																		1					4														
BURH	B	6									1																												
BURH	B	6																						1	1														
BURH	B	6												1						1					1														
BURH	Y	2				1																																
BURH	Z	2																										1										
BURH	Z	2															1																						
BURH	Z	2																		1					2														
BURH	Z	2																		1					3														
BURH	Z	2																		1					2														
BURH	Z	2																									3											
BURH	Z	3								1																													
BURO					1																																		
BURO	A	4																															1						
BURO	A	6																								1													
BURO	B	3												1																									
BURO	Z	2												1																									
BURO	Z	4																															1						
BURR	A4/B4				1																																		
BURR	A4/B4		1																																				
BURR	A4/B4					1																																	
BURR	A4/B4																										1											
BURR	A4/B4																					1																	
BURR	B	6																		1					1														
BUTH	A	4																															1						
BUTH	A	4																		1					4,3														
BUTH	A	4																				1																	
BUTH	A	4																															1						
BUTH	A	6																						1	2														
BUTH	A	6																								1													
BUTH	A	6																		1					1														
BUTH	B	1																1																					
BUTH	B	4																						1	2														
BUTH	Z	4																				1																	
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BUTH	Z	4																											1										
BUTH	Z	4									1																												
BUTH	Z	4																			71				3														
BUTH	Z	8												1																									
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BUTH	Z	8																		1					2														
BUTH	Z	8																								1													
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BUTH	Z	8																		1					2														
CASA	B	9			1																												1						
CBCA	A	3																						1	2														
CBCA	B	4																								1													
CBCA	B	4			1																																		
CBCA	B	4					1																																
CBCA	B	4																														1							
CBCA	B	4										1													3														
CBCA	B	4																1																					
CBCA	B	4				1																																	
CCLA	E	6																						1	2														
CCLA	E	8											1																										
CCLA	E	8								1																													
CCLA	E	8												1																									
CCLA	E	8	1											1																									
CCLA	F	7																						1	1														
CCLA	F	7																											1										

			FEMUR	FEMUR	FEMUR	FEMUR	TIBIA	TIBIA	TIBIA	TIBIA	HUMERUS	HUMERUS	HUMERUS	HUMERUS	RADIUS	RADIUS	ULNA	ULNA	CRANIAL	MANDIBLE	MANDIBLE	PREMAXILLA	PREMAXILLA	MAXILLA	DAMAGE	SINGLE	INCISOR	SINGLE	VERTEBRA	1/2-3/4	COMPLETE	PORTION OF	CLAVICLE	SCAPULA	SCAPULA	METAPODIAL	CALCANEUM &	
ACRONYM	SQUARE	NO	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	PROXIMAL	COMPLETE	PROXIMAL	FRAGMENT		FRAGMENT		FRAGMENT		CATEGORY	INSCISORS	FRAGMENT	MOLARS		VERTEBRA	INNOMINATE	INNOMINATE			FRAGMENT		ASTRAGALUS	COMMENTS
CCLA	F	7																		1						1												
CCLA	F	7																		1					2													
CCLA	G	6											1																									
CHAU	A	4	1																					1	2													
CHAU	Q	9																																				
CHAU	Q	9			1																																
CHAU	Q	9																						1	2													
CKEE	5/31																										1											
CKEE	F	9																		1					1													
CKEE	F	9																								1												
CKEE	F	9																																		1			
CKEE	F	9																				1																
CRAB	X	6																									1											
CRAB	X	6																									1											
CRAB	X	6																		1					2													
CRAB	Y	6																						1	1													
CRAB	Y	6																									1											
CRAB	Y	6																						1	1													
CRAB	Y	6																		1					2													
CRAB	Y	6																									2											
CRAB	Z	6																														1						
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CRAB	Z	6																1																				
CRAB	Z	6																		1					2													
CRAB	Z	6																		1					1													
CRAB	Z	6																		1					0													
CRAB	Z	6																1																				
CRAB	Z	6				1																																
CRAC	A	9																														1						
CRAC	A	9																						1	1													
CRAC	A	9																										1										
CRAC	A	9																				1							8									
CRAC	A	9																																				
CRAC	A	9																									3											
CRAC	A	9	1																																			
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CRAC	A	9								1																												
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CRAC	A	9																		1					4,0													
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CRAC	A	9																		1					4,0													
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CRAC	A	9																						1	2													
CRAC	B	9				1																																
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CRAC	B	9																	1																			
CRAC	B	9																		1					0													
CRAC	B	9																						1	0													L & R MAX JOINED, SHREW
CRAC	B	9																		1					1													
CRAC	B	9																1																				
CRAC	B	9																						1	0													L & R MAX JOINED, SHREW
CRAC	Z	9																														1						
CRAC	Z	9											1																										
CRAC	Z	9									1																												
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CRAC	Z	9							1																													
CRAC	Z	9											1																									
CRAC	Z	9																					1															
CRAC	Z	9				1																																

			FEMUR	FEMUR	FEMUR	FEMUR	TIBIA	TIBIA	TIBIA	TIBIA	HUMERUS	HUMERUS	HUMERUS	HUMERUS	RADIUS	RADIUS	ULNA	ULNA	CRANIAL	MANDIBLE	MANDIBLE	PREMAXILLA	PREMAXILLA	MAXILLA	DAMAGE	SINGLE	INCISOR	SINGLE	VERTEBRA	1/2-3/4	COMPLETE	PORTION OF	CLAVICLE	SCAPULA	SCAPULA	METAPODIAL	CALCANEUM &	
ACRONYM	SQUARE	NO	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	PROXIMAL	COMPLETE	PROXIMAL	FRAGMENT		FRAGMENT		FRAGMENT		CATEGORY	INSCISORS	FRAGMENT	MOLARS		VERTEBRA	UNKOMINATE	INKOMINATE			FRAGMENT		ASTRAGALUS	COMMENTS
CRAC	Z	9																	1						2													
CRAC	Z	9			1																																	
CRAC	Z	9																	1						1													
CRAC	Z	9																								1												
CRAC	Z	9																									2											
CRAC	Z	9															1																					
CRAC	Z	9																				1																
CRAY															1																							
CRAY	A	6	1																																			
CRAY	A	6																	1						1													
CRAY	A	6																														1						
CRAY	A	6												1																								
CRAY	A	6																	1						8													
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CRAY	A	6																						1	1													
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CRAY	A	6																		1					1													
CRAY	A	7																		1					1													
CRAY	A	7																														1						
CRAY	A	7																								3												
CRAY	A	7																				1																L & R PREMAX JOINED
CRAY	A	7																										1										
CRAY	A	7																		1					1													
CRAY	A	7																				1																L & R PREMAX JOINED
CRAY	B	6																		1					8													
CRAY	B	6																		1					2													
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CRAY	B	6							1																													
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CRAY	B	6	1																																			
CRAY	B	6																									1											
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CRAY	B	6																		1					1													
CRAY	B	6							1																													
CRAY	B	7																									1											
CRAY	X	4																													1							
CRAY	X	6																		1					1													
CRAY	X	6																		1					2													
CRAY	X	6																		1					2													
CRAY	X	8																									1											
CRAY	X	6																		1					1													
CRAY	X	6																		1					1													
CRAY	X	6									1																											
CRAY	X	6	1																																			
CRAY	Y	6																		1					1													
CRAY	Y	6												1																								
CRAY	Y	6																		1					2													
CRAY	Y	6																						1	1													
CRAY	Y	6																		1					1													
CRAY	Y	6																		1					3													
CRAY	Y	6																						1	1													
CRAY	Z	6																	2																			
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CRAY	Z	9																																				
CRAY	Z	6																							1													
CRAY	Z	6																																				

			FEMUR	FEMUR	FEMUR	FEMUR	TIBIA	TIBIA	TIBIA	TIBIA	HUMERUS	HUMERUS	HUMERUS	HUMERUS	RADIUS	RADIUS	ULNA	ULNA	CRANIAL	MANDIBLE	MANDIBLE	PREMAXILLA	PREMAXILLA	MAXILLA	DAMAGE	SINGLE	INCISIOR	SINGLE	VERTEBRA	1/2-3/4	COMPLETE	PORTION OF	CLAVICLE	SCAPULA	SCAPULA	METAPODIAL	CALCANEUM &	
ACRONYM	SQUARE	NO	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	PROXIMAL	COMPLETE	PROXIMAL	FRAGMENT		FRAGMENT		FRAGMENT		CATEGORY	INSCISORS	FRAGMENT	MOLARS		VERTEBRA	INNOMINATE	INNOMINATE			FRAGMENT		ASTRAGALUS	COMMENTS
CRAY	Z	6																											1									
DAAH	Z	1																														1							
DAAH	Z	3																						1	1														
DAAH	Z	3																		71																			
DAAH	Z	3							1																														
DAAH	Z	3																						1	1														
DAAH	Z	4																														1							
DAAH	Z	6																				1																	
DAAH	Z	6																														1							
DBRA	A	7																														1							
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DBRA	A	8																		1					3,4														SHAFTS
DBRA	A	8																						1	2														
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DBRA	A	9																														1							
DBRA	B	7						1						1																									
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DBRA	B	7											1																										
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ACRONYM	SQUARE	NO	FEMUR COMPLETE	FEMUR SHAFT	FEMUR PROXIMAL	FEMUR DISTAL	TIBIA COMPLETE	TIBIA SHAFT	TIBIA PROXIMAL	TIBIA DISTAL	HUMERUS COMPLETE	HUMERUS SHAFT	HUMERUS PROXIMAL	HUMERUS DISTAL	RADIUS COMPLETE	RADIUS PROXIMAL	ULNA COMPLETE	ULNA PROXIMAL	CRANIAL FRAGMENT	MANDIBLE	MANDIBLE FRAGMENT	PREMAXILLA	PREMAXILLA FRAGMENT	MAXILLA	DAMAGE CATEGORY	SINGLE INCISORS	INCISOR FRAGMENT	SINGLE MOLARS	VERTEBRA	1/2-3/4 VERTEBRA	COMPLETE INNOMINATE	PORTION OF INNOMINATE	CLAVICLE	SCAPULA	SCAPULA FRAGMENT	METAPODIAL	CALCANEUM & ASTRAGALUS	COMMENTS
DBRA	8	7				1																																
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DBRA	8	7																		1					3													[illegible]
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DBRA	8	8												1																								
DBRA	8	8						1																														
DBRA	8	8																		1					1													
DBRA	8	8																1																				
DBRA	8	8																										4										
DBRA	8	8																																				LONG BONE FRAGMENT
DBRA	8	8																		1					1													
DBRA	8	8				1																																
DBRA	8	8			1																																	
DBRA	8	8				1																																
DBRA	8	8																						1	1													
DBRA	8	8																						1	3													
DBRA	8	8																						1	3													
DBRA	8	8																														1						
DBRA	8	8								1																												
DBRA	8	8																		1					3													
DBRA	8	8																									9											
DBRA	8	8																				1																
DBRA	8	8				1																																
DBRA	8	8																																		3		
DBRA	8	8																					2															
DBRA	8	8			1																																	
DBRA	8	8									1																											
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DBRA	8	8			1																																	
DBRA	8	8																		1					1													
DBRA	8	8											1																									
DBRA	8	8																						1	2													
DBRA	8	8																					1															
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DBRA	8	8																					1															
DBRA	8	8																				1																
DBRA	Z	7																										1										
DBRA	Z	7			1																																	
DBRA	Z	7																						1	2													
DBRA	Z	7																										2										
DBRA	Z	7																											2									
DECE	8	8																1																				
DEF	Z	9																														1						
DEF	Z	9																										1										
DEF	Z	9																	1																			

ACRONYM	SQUARE	NO	FEMUR COMPLETE	FEMUR SHAFT	FEMUR PROXIMAL	FEMUR DISTAL	TIBIA COMPLETE	TIBIA SHAFT	TIBIA PROXIMAL	TIBIA DISTAL	HUMERUS COMPLETE	HUMERUS SHAFT	HUMERUS PROXIMAL	HUMERUS DISTAL	RADIUS COMPLETE	RADIUS PROXIMAL	ULNA COMPLETE	ULNA PROXIMAL	CRANIAL FRAGMENT	MANDIBLE	MANDIBLE FRAGMENT	PREMAXILLA	PREMAXILLA FRAGMENT	MAXILLA	DAMAGE CATEGORY	SINGLE INCISORS	INCISOR FRAGMENT	SINGLE MOLARS	VERTEBRA	1/2-3/4 VERTEBRA	COMPLETE INNOMINATE	PORTION OF INNOMINATE	CLAVICLE	SCAPULA	SCAPULA FRAGMENT	METAPODIAL	CALCANEUM & ASTRAGALUS	COMMENTS
DEF	Z	9			1															1					4,1													
DEF	Z	9								1															2				2									
DEF	Z	9								1																											
DEF	Z	9																		1					4,1												
DIDO	X	6																						1	2												
DIDO	X	6																											1								
DIDO	X	6																		1					3												
DIDO	X	6							1																												
DIDO	X	6																						1	1												
DIDO	X	6			1																																
DIDO	X	6															1																				
DIDO	Y	6								1																											
DIDO	Y	6								1																											
DIDO	Y	6																									1										
DIDO	Y	6	1																																		
DIDO	Y	6																		1					4												
DIDO	Y	6								1																											
DOL2	D	10																				1															
DOL3	E	9																		1					1												
DOL2	E	9																										1									
DOL2	E	9																		1					1												
DOL2	E	9																		1					1												
DOL2	F	9			1																	1															
DOL3	G	9																						1	1												
DOL3	G	8																								1											
DOL2	G	8									1																										
DOLA	6/31																			1					1												
DOLA	6/31																							1	1												
DOLA	C	7												1																							
DOLA	C	7																											2								
DOLA	C	7																											1								
DOLA	C	7																		1					1												
DOLA	C	7															1																				
DOLA	C	7															1																				
DOLA	D	7																								1											
DOLA	E	7															1																				
DOLA	E	9																		1					1												
DOLA	E	9																								1											
DOLA	F	9																											1								
DOLL																							1														
DOLL	C	9								1																											
DOLL	C	9			1																	1															
DOLL	C	9																								8											
DOLL	C	9												1																							
DOLL	C	9																		1					1,4											ELEPHANT SHREW
DOLL	C	9																		1					4											ELEPHANT SHREW, PROBOSCIS ALMOST COMPLETE
DOLL	C	9																				1															LGR PREMAX JOINED
DOLL	C	9						1																										1			
DOLL	C	9																								1											
DOLL	C	9																											2								
DOLL	C	9			1																																
DOLL	C	9												1																							
DOLL	C	9																				1															LGR PREMAX JOINED
DOLL	C	9																				1															
DOLL	C	9												1																							
DOLL	C	9																				1															
DOLL	C	9																		1					2											
DOLL	C	9												1																							
DOLL	D	9										1																									
DOLL	D	9																						1	2												
DOLL	D	9																		1					1												
DOLL	E	9																						2	2												
DOLL	E	9			1																																
DOLL	E	9			2																																
DOLL	E	9																											10								
DOLL	E	9																				1															
DOLL	E	9																		1					3												
DOLL	E	9																						1	2												
DOLL	E	9												3																							
DOLL	E	9																				1															
DOLL	E	9																		1					3												
DOLL	E	9																		71					3	1											
DOLL	E	9																				1															
DOLL	E	9																		1					4												
DOLL	E	9												2																							
DOLL	E	9																		71					3												
DOLL	E	9																										2									
DOLL	E	9																								8											
DOLL	E	9																		1					4												SHREW
DOLL	E	9																														1					
DOLL	E	9																						1	2												
DOLL	E	9																		1					2												ELEPHANT SHREW
DOLL	E	9																		1					1	1											SHREW
DOLL	E	9																		1					3												

			FEMUR	FEMUR	FEMUR	FEMUR	TIBIA	TIBIA	TIBIA	TIBIA	HUMERUS	HUMERUS	HUMERUS	HUMERUS	RADIUS	RADIUS	ULNA	ULNA	CRANIAL	MANDIBLE	MANDIBLE	PREMAXILLA	PREMAXILLA	MAXILLA	DAMAGE	SINGLE	UNICHEOR	SINGLE	VERTEBRA	1/2-3/4	COMPLETE	PORTION OF	CLAVICLE	SCAPULA	SCAPULA	METAPODIAL	CALCANEUM &	
ACRONYM	SQUARE	NO	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	PROXIMAL	COMPLETE	PROXIMAL	FRAGMENT		FRAGMENT		FRAGMENT		CATEGORY	INCISORS	FRAGMENT	MOLARS		VERTEBRA	INNOMINATE	INNOMINATE			FRAGMENT		ASTRAGALUS	COMMENTS
DOLL	E	9																				1																
DOLL	E	9																													1								
DOLL	E	9																																			2		
DOLL	E	9																									5												
DOLL	E	9				1																																	
DOLL	E	9																						1	2														
DOLL	E	9																						1	1														
DOLL	E	9																		1					1														
DOLL	E	9																														1							
DOLL	E	10																		1					2														
DOLL	E	10																			71				3														
DOLL	E	10																		1					3														
DOLL	E	10								2																													
DOLL	E	10																						1	2														
DOLL	E	10			1																																		
DOLL	E	10																		1					3														
DOLL	E	10			1																																		
DOLL	E	10																		1					1														
DOLL	E	10												2						1					3														
DOLL	E	10																																					
DOLL	E	10																						1	2														
DOLL	E	10																																					
DOLL	E	10																		1					3														
DOLL	E	10				1																																	
DOLL	E	10																						1	2														
DOLL	E	10															1																							
DOLL	E	10																		1					2														
DOLL	E	10																		1					1														
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DOLL	E	10																																					
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DOLL	E	10																						1	2														
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DOLL	E	10																				10																	
DOLL	E	10																						1	2														
DOLL	E	10																						1	2														
DOLL	E	10																	6																					
DOLL	E	10																									1												
DOLL	E	10																																					
DOLL	E	10																							2														
DOLL	E	10																			71				3.4														
DOLL	E	10																								21													
DOLL	E	10																				12																	
DOLL	E	10												6																									
DOLL	E	10																		1					4														SHREW
DOLL	E	10																						1	2														
DOLL	E	10																																			3		
DOLL	E	10																		1					0														SHREW
DOLL	E	10																				4																	
DOLL	E	10																		1					3														
DOLL	E	10																		1					1														
DOLL	E	10																		1					2														
DOLL	E	10																		1					3,4														
DOLL	E	10																		1					1														SHREW
DOLL	E	10																		1					2														
DOLL	E	10																		1					4														
DOLL	E	10																		1					3														
DOLL	E	10				1																																	
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DOLL	E	10												1																									
DOLL	E	10																															9						
DOLL	E	10																										11											
DOLL	E	10											1																										
DOLL	E	10												1																									
DOLL	E	10																						1	8														L & R MAX JOINED SHREW
DOLL	E	10																		1					1														
DOLL	E	10																		1					2														
DOLL	E	10																						72	3														SHREW
DOLL	E	10																		1					2														
DOLL	E	10																						1	8														L & R MAX JOINED, SHREW
DOLL	E	10																		1					3														
DOLL	E	10																		1					0														
DOLL	E	10																		1					2														
DOLL	E	10																		1					3														
DOLL	E	10																						1	8														L & R MAX AND PREMAX JOINED, SHREW
DOLL	E	10																								2													
DOLL	E	10																5																						
DOLL	E	10																		1					3														ELEPHANT SHREW
DOLL	E	10																		1					3														
DOLL	E	10																		1					2														
DOLL	E	10																				1																	L & R MAX AND PREMAX FRAG JOINED SHREW
DOLL	E	10																															1						
DOLL	E	10																		1					1														ELEPHANT SHREW

ACRONYM	SQUARE	NO	FEMUR COMPLETE	FEMUR SHAFT	FEMUR PROXIMAL	FEMUR DISTAL	TIBIA COMPLETE	TIBIA SHAFT	TIBIA PROXIMAL	TIBIA DISTAL	HUMERUS COMPLETE	HUMERUS SHAFT	HUMERUS PROXIMAL	HUMERUS DISTAL	RADIUS COMPLETE	RADIUS PROXIMAL	ULNA COMPLETE	ULNA PROXIMAL	CRANIAL FRAGMENT	MANDIBLE	MANDIBLE FRAGMENT	PREMAXILLA	PREMAXILLA FRAGMENT	MAXILLA	DAMAGE CATEGORY	SINGLE INCISORS	INCISOR FRAGMENT	SINGLE MOLARS	VERTEBRA	1/2-3/4 VERTEBRA	COMPLETE INNOMINATE	PORTION OF INNOMINATE	CLAVICLE	SCAPULA	SCAPULA FRAGMENT	METAPODIAL	CALCANEUM & ASTRAGALUS	COMMENTS
DOLL	E	10			1																																	
DOLL	E	10																				1																L & R MAX AND PREMAX JOINED, SHREW
DOLL	E	10																		1					6													
DOLL	E	10																		1					3,4													
DOLL	E	10																		1					3													
DOLL	E	10																														1						
DOLL	E	10				1																																
DOLL	E	10				2																																
DOLL	E	10																						1	3													
DOLL	E	10																														8						
DOLL	E	10				1																																
DOLL	E	10				1																																
DOLL	E	10				1																																
DOLL	E	10				1																																
DOLL	E	10																		1					4													
DOLL	E	10																				1																
DOLL	E	10																														1						
DOLL	E	10											2																									
DOLL	E	10																6																				
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DOLL	E	10																						1	1													
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DOLL	E	10			1																																	
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DOLL	E	10											1																									
DOLL	E	10																		1					3													
DOLL	E	10														2																						
DOLL	E	10																						1	6													L & R MAX AND PREMAX JOINED SHREW
DOLL	E	10																								6												
DOLL	E	10																														1						
DOLL	E	10									1																											
DOLL	E	10																		1					2													
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DOLL	E	10											1																									
DOLL	E	10																						71	3													
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DOLL	E	10								1																												
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DOLL	E	10			4																																	
DOLL	E	10																																		1		
DOLL	E	10																											68									
DOLL	E	10					1																															
DOLL	E	10																		1					4													SHREW
DOLL	E	10	3																																			
DOLL	E	10																						1	2													
DOLL	E	10	2																																			
DOLL	E	10								3																												
DOLL	E	10								2																												
DOLL	E	10																						1	1													
DOLL	E	10																						1	2													
DOLL	E	10																																		7		
DOLL	E	10																		1					4													SHREW
DOLL	E	10																						1	2													
DOLL	E	10																						1	2													
DOLL	E	10								1																												

			FEMUR	FEMUR	FEMUR	FEMUR	TIBIA	TIBIA	TIBIA	TIBIA	HUMERUS	HUMERUS	HUMERUS	HUMERUS	RADIUS	RADIUS	ULNA	ULNA	CRANIAL	MANDIBLE	MANDIBLE	PREMAXILLA	PREMAXILLA	MAXILLA	DAMAGE	SINGLE	INCISOR	SINGLE	VERTEBRA	1/2-3/4	COMPLETE	PORTION OF	CLAVICLE	SCAPULA	SCAPULA	METAPODIAL	CALCANEUM &	
ACRONYM	SQUARE	NO	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	PROXIMAL	COMPLETE	PROXIMAL	FRAGMENT		FRAGMENT		FRAGMENT		CATEGORY	INCISORS	FRAGMENT	MOLARS		VERTEBRA	INNOMINATE	INNOMINATE			FRAGMENT		ASTRAGALUS	COMMENTS
DOLL	E	10								1										1					1													
DOLL	E	10																																				
DOLL	E	10																						1	2													
DOLL	E	10						1																														
DOLL	E	10			7																																
DOLL	E	10							1																													
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DOLL	E	10																														1						
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DOLL	E	10							2																													
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DOLL	E	10								1																												
DOLL	E	10								1																												
DOLL	E	10																												15								
DOLL	E	10																																	1			
DOLL	E	10																		1					4													SHREW
DOLL	E	10							1																													
DOLL	E	10								1																												
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DOLL	E	10																						1	2													
DOLL	E	10																						1	2													
DOLL	E	10					1																															
DOLL	F	6																								1												
DOLL	F	6			1																																	
DOLL	F	8												1																								
DOLL	F	8																									2											
DOLL	F	8																		1					2													
DOLL	F	8																						71	3													
DOLL	F	9																										3										
DOLL	F	9								1																												
DOLL	F	9																						1	2													
DOLL	F	9																								4												
DOLL	F	9																														1						
DOLL	F	9																				1																
DOLL	F	10																						1	1													
DOLL	F	10								1																												
DOLL	F	10																										6										
DOLL	F	10	1																																			
DOLL	F	10																								2												
DOLL	F	10																																	1			
DOLL	F	10																				1																
DOLL	F	10																		1					3													SLEPHANT SHREW
DOLL	F	10																		1					4													
DOLL	F	10																									1											
DOLL	F	10												3																								
DOSU																1																						
DOSU																1																						
DOSU																1																						
DOSU																								1	2													
DOSU																1																						
DOSU																1																						
DOSU																						1																
DOSU																						1																
DOSU																1									2													
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DOSU																								1	2													
DOSU																																						
DOSU	D	9													1																							
DOSU	D	9														1																						
DOSU	D	9																						1	1													
DOSU	D	9																		1					1													L & R MAXILLA JOINED
DOSU	D	9																							2													
DOSU	D	9																						1	0													L & R PREMAX AND MAX JOINED, SHREW
DOSU	D	9																						1	0													L & R MAXILLA JOINED
DOSU	D	9																		1					1													
DOSU	D	9						1																														
DOSU	D	9					1																															
DOSU	D	9							1																													
DOSU	D	9																				1																L & R PREMAX AND MAX JOINED, SHREW
DOSU	D	9																						1	2													
DOSU	D	9																						1	1													
DOSU	D	9																						1	2													
DOSU	D	9																									6											
DOSU	D	9																										22										
DOSU	D	9												1																								
DOSU	D	9																						1	2													
DOSU	D	9																						1	2													
DOSU	D	9																		1					2													
DOSU	D	9																							2													

			FEMUR	FEMUR	FEMUR	FEMUR	TIBIA	TIBIA	TIBIA	TIBIA	HUMERUS	HUMERUS	HUMERUS	HUMERUS	RADIUS	RADIUS	ULNA	ULNA	CRANIAL	MANDIBLE	MANDIBLE	PREMAXILLA	PREMAXILLA	MAXILLA	DAMAGE	SINGLE	INCISOR	SINGLE	VERTEBRA	1/2-3/4	COMPLETE	PORTION OF	CLAVICLE	SCAPULA	SCAPULA	METAPODIAL	CALCANEUM &	
ACRONYM	SQUARE	NO	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	PROXIMAL	COMPLETE	PROXIMAL	FRAGMENT		FRAGMENT		FRAGMENT		CATEGORY	INCISORS	FRAGMENT	MOLARS		VERTEBRA	INNOMINATE	INNOMINATE			FRAGMENT		ASTRAGALUS	COMMENTS
DOSU	D	9																								13												
DOSU	D	9																						1	1														
DOSU	D	9							1																													
DOSU	D	8																						1	9													L & R PREMAX AND MAX JOINED, SHREW
DOSU	D	9																				1																L & R PREMAX AND MAX JOINED, SHREW
DOSU	D	9																						1	3													
DOSU	D	9											1																									
DOSU	D	9												6																								
DOSU	D	9				1																																
DOSU	D	9			6																																
DOSU	D	9																	3																			
DOSU	D	9																																	1			
DOSU	D	9																																	1			
DOSU	D	9			1																																
DOSU	D	9			6																																
DOSU	D	9																		1					1													SHREW
DOSU	D	9																		1					1,4													ELEPHANT SHREW
DOSU	D	9																		1					1													ELEPHANT SHREW
DOSU	D	9																		1					1													ELEPHANT SHREW
DOSU	D	9																															3					
DOSU	D	9																															4					
DOSU	D	9																											2									
DOSU	D	9																										2										
DOSU	D	9															1																					
DOSU	D	9																		1					3													
DOSU	D	9																		1					2,4													
DOSU	D	9																						1	2													
DOSU	D	9																					1															
DOSU	D	9																		1					8													
DOSU	D	9				1																																
DOSU	D	9																		1					2													
DOSU	D	9																										10										
DOSU	D	9				1																																
DOSU	D	9				1																																
DOSU	D	9																																			1	
DOSU	D	9			1																																	
DOSU	D	9																			72																	
DOSU	D	9																				1																
DOSU	D	8				1																																
DOSU	D	8																				1																
DSO3	D	8											1																										
DSO4																											6											
DSO6	?	7																												1								
DSO8																															1							
DUST	A	1			1																																	
DUST	A	2																											1									
DUST	A	3																														1						
DUST	A	3																								1												
DUST	A	3			1																																	
DUST	A	2					1																															
DUST	A3/B3										1																											
DUST	B	2																														1						
DUST	B	3																									1											
DUST	B	3																											1									
DUST	K	2							1																													
DUST	Y	2			1																																	
DUST	Y	3																														1						
DUST	Y	2																		1					8													SHREW
DUST	Y	3							1																													
DUST	Y	3																														1						
DUST	Z	2																		1					1													
DUST	Z	2																		1					8													SHREW
DUST	Z	2			1																																	
DUST	Z	3	1																																			
DUST	Z	3																		1					1													SHREW
DUST	Z	3																		1					1													
DUST	Z	4																											1									

			FEMUR	FEMUR	FEMUR	FEMUR	TIBIA	TIBIA	TIBIA	TIBIA	HUMERUS	HUMERUS	HUMERUS	HUMERUS	RADIUS	RADIUS	ULNA	ULNA	CRANIAL	MANDIBLE	MANDIBLE	PREMAXILLA	PREMAXILLA	MAXILLA	DAMAGE	SINGLE	INCISIOR	SINGLE	VERTEBRA	1/2-3/4	COMPLETE	PORTION OF	CLAVICLE	SCAPULA	SCAPULA	METAPODIAL	CALCANEUM &	
ACRONYM	SQUARE	NO	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	PROXIMAL	COMPLETE	PROXIMAL	FRAGMENT		FRAGMENT		FRAGMENT		CATEGORY	INCISORS	FRAG	MOLARS		VERTEBRA	INNOMINATE	INNOMINATE			FRAGMENT		ASTRAGALUS	COMMENTS
EDDI																								1	2													
EDDI																											1											
EDDI																				1					1													
EDDI																				1					1													
EDDI																								1	2													
EDDI																				1					2													
EDDI																				1					1													
EDDI																				1					1													
EDDI																				1					2													
EDDI																						1																L & R PREMAX JOINED
EDDI																						1																L & R PREMAX JOINED
EDDI																						1																
EDDI																				1					8													
EDDI																				1					3,4													
EDDI																						1																
EDDI																				1					3													
EDDI																				1					1													
EDDI																						1																
EDDI																								1	1							1						
EDDI	C	6																														2						
EDDI	C	6																																				
EDDI	C	6			1																	1																
EDDI	C	6																				1																
EDDI	C	6																				1																
EDDI	C	6																	2																				
EDDI	C	6																										9										
EDDI	C	6																		1					1													
EDDI	C	6			1																																	
EDDI	C	6																																				
EDDI	C	6																			71				3													
EDDI	C	6																						1	1													
EDDI	C	6											1																									
EDDI	C	6								1														1	1													
EDDI	C	6																		1					2										1			
EDDI	C	6																																			1	
EDDI	C	6																1														1						
EDDI	C	6																1										4										
EDDI	C	6																1																				
EDDI	C	6																						71	3													
EDDI	C	6																									4											
EDDI	C	6																						1	3													
EDDI	C	6																						1	1													
EDDI	C	6												2																								
EDDI	C	6																														1						
EDDI	C	6																																				
EDDI	C	6																														1						
EDDI	C	6												1																							2	
EDDI	C	6																		1					4													
EDDI	C	6																						1	3													
EDDI	C	6												4																								
EDDI	D	4			1																																	
EDDI	D	4									1																											
EDDI	D	4			1																																	
EDDI	D	4																											1									
EDDI	D	4									1																											
EDDI	D	4												1																								
EDDI	D	4									1																											
EDDI	D	4																														1						
EDDI	D	4																									1											
EDDI	D	5																														1						
EDDI	D	5			1																																	
EDDI	D	6																														1						
EDDI	D	6								1																												
EDDI	D	6								1																												
EDDI	D	6																														1						
EDDI	E	4												1																								
EDDI	E	5						1																														
EDDI	E	6												1																								
EDDI	E	7																						1	2													
EDDI	E	7																		1					1													
ELEP	X	4																												1								
ELEP	X	4																														1						
ELFO	Y	5			1																																	
ELFO	Y	5			1																																	
ELFO	Y	6																														1						
ELPR	F	6	1																																			
ELPR	F	6			1																																	
ELPR	F	6																		1					1													
ELPR	F	6																		1					9													
ELPR	F	6			1																																	
ELPR	F	6																									1											
ELPR	F	6																								1												
ELPR	F	6											1																									

			FEMUR	FEMUR	FEMUR	FEMUR	TIBIA	TIBIA	TIBIA	TIBIA	HUMERUS	HUMERUS	HUMERUS	HUMERUS	RADIUS	RADIUS	ULNA	ULNA	CRANIAL	MANDIBLE	MANDIBLE	PREMAXILLA	PREMAXILLA	MAXILLA	DAMAGE	SINGLE	BISCISOR	SINGLE	VERTEBRA	1/2-3/4	COMPLETE	PORTION OF	CLAVICLE	SCAPULA	SCAPULA	METAPODIAL	CALCANEUM &	
ACRONYM	SQUARE	NO	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	PROXIMAL	COMPLETE	PROXIMAL	FRAGMENT		FRAGMENT		FRAGMENT		CATEGORY	INSICSORS	FRAG	MOLARS		VERTEBRA	INNOMINATE	INNOMINATE			FRAGMENT		ASTRAGALUS	COMMENTS
ELPR	F	6																						1	1													
ELPR	G	6																				1																	L & R PREMAX JOINED
ELPR	G	6																				1																	L & R PREMAX JOINED
ELPR	G	6																								2													
EUSE	C	7																		1					1														
EUSE	C	7																		1					2														
EUSE	C	7																								1												
EUSE	C	7																		1					1														
EUSE	C	7																		1					1														
EUSE	D	6													1																								
EUSE	D	6																						1	2														
EUSE	D	6																								2													
EUSE	D	6																										2					1						
EUSE	D	6													1																								
EUSE	D	6																1																					
EUSE	D	6									1																												
EVGO	E	9																						1	2														
EVGO	E	9																		1					3														
EVGO	E	9																						1	1														
EVGO	E	9																								2													
EVGO	E	9																						1	1														
EVGO	E	9																						1	1														
EVGO	E	9																		1					1														
EVGO	E	9																																					
EVGO	E	9																		1					3														
EVGO	E	9																						1	3														
EVGO	E	9																		1					2														
EVGO	E	9																										16											
EVGO	E	9																				1																	
EVGO	E	9																				1																	
EVGO	E	9															1																						
EVGO	E	9																		1					4														
EVGO	E	9																		1					0														SHREW
EVGO	E	9																									2												
EVGO	E	9													1																								
EVGO	E	9																		1					3														
EVGO	E	9													1																								
EVGO	E	9																						1	2														
EVGO	E	9													1																								
EVGO	E	9	1																																				
EVGO	E	9	1																																				
EVGO	E	9																														1							
EVGO	E	9																														1							
EVGO	E	9																														1							
EVGO	E	9													1																								
EVGO	E	9													1																								
EVGO	E	9																	2																				
EVGO	E	9																				1																	
EVGO	E	9																		1					2														
EVGO	E	9																										2											
EVGO	E	9																		1					0														SHREW
EVGO	E	9																		1					1														
EVGO	E	9																						1	2														
EVGO	E	9							1																														
EVGO	E	9			1																																	
EVGO	E	9			1																																	
EVGO	E	9				1																																
EVGO	E	9				4																																
FAKE	B	6														1																							
FIPA	C	6			1																																	
FIPA	C	6			1																																	
FIPA	D	6																		1					3,4														
FIPA	D	6																														1							
FLIP	A	6																														1							
FLIP	A	6																						1	1														
FLIP	A	6																														1							
FLIP	A	6																						1	2														
FLIP	B	6																				1																	
FLIP	B	6																										4											
FLIP	B	6																				1																	
FLIP	B	6							1																														
FLIP	B	6	1																																				
FLIP	B	6									1																												
FLIP	B	6																		1					3														
FLIP	B	6																								2													
FLIP	B	6																							4,1														
FLIP	B	6																														1							
FLIP	B	6																						1	2														
FLIP	B	6																														1							
FLIP	B	6																						1	1														
FLIP	B	6																		1					3														
FLIP	B	6																		1					1														
FLIP	B	6																														1							
FLIP	B	6																														1							
FLIP	B	6	1																																				
FLIP	B	6																		1					2														
FLIP	B	6						1																															

			FEMUR	FEMUR	FEMUR	FEMUR	TIBIA	TIBIA	TIBIA	TIBIA	HUMERUS	HUMERUS	HUMERUS	HUMERUS	RADIUS	RADIUS	ULNA	ULNA	CRANIAL	MANDIBLE	MANDIBLE	PREMAXILLA	PREMAXILLA	MAXILLA	DAMAGE	SINGLE	INCISIOR	SINGLE	VERTEBRA	1/2-3/4	COMPLETE	PORTION OF	CLAVICLE	SCAPULA	SCAPULA	METAPODIAL	CALCANEUM &	
ACRONYM	SQUARE	NO	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	PROXIMAL	COMPLETE	PROXIMAL	FRAGMENT		FRAGMENT		FRAGMENT		CATEGORY	INCISORS	FRAG	MOLARS		VERTEBRA	INNOMINATE	INNOMINATE			FRAGMENT		ASTRAGALUS	COMMENTS
FLIP	B	6																		1					8													
FLIP	B	8																						1	1														
FNLA	B	7																		1					1														
FOAM	A	8											1																										
FOAM	A	0									1																												
FOAM	A	3			1																																	
FOAM	A	2				1																																
FOAM	A	3																						1	1														
FOAM	A	3																1																					
FOAM	A	3					1																																
FOAM	A	6										71																											
FOAM	B	1																									1												
FOAM	B	1																			71				3								1						
FOAM	B	1																		1					2														
FOAM	B	1																																					
FOAM	B	72												1																		1							
FOAM	D	4	1																																				
FOAM	D	4									1																												
FOAM	X	2																															1						
FOAM	X	2																		1					1														SHREW
FOAM	X	2																															1						
FOAM	Y	3																											1										
FOAM	Y	3																																					
FOAM	Y	3									1																												
FOAM	Z	2			1																																		
FOAM	Z	2										1																											
FOAM	Z	2												1																									
FOAM	Z	4	1																																				
FOAM	Z	4																															1						
FOCA	A	2																		1					1														
FOCA	A	2												1																									
FOCA	A	3																											1										
FOCA	Y	2																										1											
FOCA	Y	3									1																1												
FOCA	Z	2																															1						
FOCA	Z	3																		1					1														
FOCA	Z	3																		1					1														
FORE	X	4																		1					8														
FORE	X	4																		1					1														
FORE	X	6							1																														
FORE	Y	6																						1	2														
FORE	Y	6																						1	8														L & R MAX JOINED SHREW
FORE	Y	6																						1	8														L & R MAX JOINED SHREW
FORE	Y	6																						1	2														
FORE	Y	6																									1												
FORE	Y	6																				1																	
FORE	Y	6																		1					1														
FORE	Y	6																		1					8														
FORE	Y	6																				1																	
FORE	Y	6									1																												
FORE	Y	6																						1	1														
FORE	Y	6																		1					1														
FORE	Y	6																		1					1														
FORE	Z	6					1																																
FORE	Z	6																		1					3														
FORE	Z	6								1																													
FORE	Z	6																						1	3														
FORE	Z	6																		2					2														
FORE	Z	6																		1					1														
FRTU	X	3												1																									
GADD	A	7																						1	2														
GADD	A	7												1																									
GADD	A	7																						1	3														
GADD	A	7																		1					3														
GADD	A	8																		1					3														
GADD	A	8												1																									
GADD	A	8																										1											
GADD	A	8																									1												
GADD	A	8																		1					3														
GADD	A	8			1																																		
GADD	B	9																						1	2														
GADD	B	9				1																																	
GADD	B	9								1																													
GADD	B	9			1																																		
GADD	B	9																		1					3,4														
GADD	B	9																												4									
GADD	B	9																				1																	
GADD	B	9																										1											
GADD	B	9																								1													
GADD	B	9			1																																		
GADD	B	9																						1	3														SHREW
GADD	Z	7																						1	2														
GALI	X	4																																					
GASO	6/51																									1													
GASO	6/51																					71																	
GASO	6/51																			1					1														
GASO	C	3																		1					2														

ACRONYM	SQUARE	NO	FEMUR COMPLETE	FEMUR SHAFT	FEMUR PROXIMAL	FEMUR DISTAL	TIBIA COMPLETE	TIBIA SHAFT	TIBIA PROXIMAL	TIBIA DISTAL	HUMERUS COMPLETE	HUMERUS SHAFT	HUMERUS PROXIMAL	HUMERUS DISTAL	RADIUS COMPLETE	RADIUS PROXIMAL	ULNA COMPLETE	ULNA PROXIMAL	CRANIAL FRAGMENT	MANDIBLE	MANDIBLE FRAGMENT	PREMAXILLA	PREMAXILLA FRAGMENT	MAXILLA	DAMAGE CATEGORY	SINGLE INCISORS	INCISOR FRAG	SINGLE MOLARS	VERTEBRA	1/2-3/4 VERTEBRA	COMPLETE INNOMINATE	PORTION OF INNOMINATE	CLAVICLE	SCAPULA	SCAPULA FRAGMENT	METAPODIAL	CALCANEUM & ASTRAGALUS	COMMENTS
QA5O	C	3																		1					1,4				1										
QA5O	C	3												1																									
QA5O	D	5								1																						1							
QA5O	D	5																				1																
QB1A	B	1																		1					1													
QB1A	Y	4																		1					2													
QB1A	Y	4																																				
QB1A	Y	4	1																																			
QB1A	Z	4				1																																
QB1A	Z	4																											1									
QB1A	Z	4								71																												
QB1B					1																																	
QB1B	Y					1																															1	
QB1B	Y		1																																			
QB1B	Y	3	1																																			
QB1B	Y	4												1																								
QB1B	V	4								1																											1	
QB1B	Y	4																																				
QB1B	Y	4	1																																			
QB1B	Y	4																																				
QB1B	Y	4									71																											
QB1B	Z	2																		1					4													B-NEW
QB1B	Z	2																		1					3										2			B-NEW
QB1B	Z	3																		1					1													
QB1B	Z	3																												1								
QB1C	C	3																																				
QB1C	C	4					1																															
QB1C	Y	4																				1																
QB1C	Z	2						1																														
QB1C	Z	4																				1															1	
QB2A	X	2																														1							
QB2A	X	3									1																												
QB2A	X	4																		1					3													
QB2A	Y	2																										2										
QB2A	Z	4			1																								1									
QB2A	Z	4																																				
QB2A	Z	4					1																															
QBAN																				1					1													
QBAN	6/91																			1					1													
QBAN	6/91																			1					2													
QBAN	6/91																			1					1													
QBAN	6/91																			1					1													
QBAN	6/91																							1	2													
QBAN	6/91																					1																
QBAN	6/91																					1																
QBAN	C	3			1																																	
QBAN	E	3	1																																			
QBAN	E	4			1																																	
QBAN	E	4									1																											
QBAN	E	4																											1									
QBAN	E	4								1																												
QBAN	E	4																														1						
QBAN	E	4								1																												
QBAN	E	5																				1					1											
QBAN	E	5																						1	2													
QBAN	E	5																		1					1													
QBAN	E	5																		1					1													
QBAN	E	5																														1						
QBAN	E	5			1																																	
QBAN	E	6																1																				
QBAN	E	6									1																											
QBAN	E	6			1																																	
QBAN	E	6																1																				
QBAN	E	6																		1					1													
QBAN	F	3																				1																
QBAN	F	3																														1						
QBAN	F	3								1																												
QBAN	F	3																														1						
QBAN	F	4									1																											
QBAN	F	4																																				
QBAN	F	4																				1																
QBAN	F	4	1																																			
QBAN	F	4									1																											
QBAN	F	4																														1						
QBAN	F	5									1																											
QBAN	F	5																														1						
QBAN	F	6	1																																			
QBAN	G	3			1																																	
QBAN	G	3											1																									
QBAN	G	4					1																															
QB51	A	1								1																												
QB51	A	3																												1								
QB51	A	3									1																											

			FEMUR	FEMUR	FEMUR	FEMUR	TIBIA	TIBIA	TIBIA	TIBIA	HUMERUS	HUMERUS	HUMERUS	HUMERUS	RADIUS	RADIUS	ULNA	ULNA	CRANIAL	MANDIBLE	MANDIBLE	PREMAXILLA	PREMAXILLA	MAXILLA	DAMAGE	SINGLE	INCISOR	SINGLE	VERTEBRA	1/2-3/4	COMPLETE	PORTION OF	CLAVICLE	SCAPULA	SCAPULA	METAPODIAL	CALCANEUM &	
ACRONYM	SQUARE	NO	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	PROXIMAL	COMPLETE	PROXIMAL	FRAGMENT		FRAGMENT		FRAGMENT		CATEGORY	INCISORS	FRAG	MOLARS		VERTEBRA	INNOMINATE	INNOMINATE			FRAGMENT		ASTRAGALUS	COMMENTS
GBS1	A	3			1																																
GBS1	A	3	1																																		
GBS1	A	6			1																																
GBS1	A	6																										1									
GBS1	A	6				1																															
GBS1	B	2																													1						
GBS1	B	2																		1					2											1	
GBS1	C	2																		1					2												
GBS1	C	2																										1									
GBS1	Y	2			1																																
GBS1	Y	2																																			
GBS1	Y	2			1																																
GBS1	Z	2										1																									
GBS1	Z	2																												1							
GBS1	Z	2																														1					
GBS1	Z	2			1																																
GBS1	Z	2																								1											
GBS1	Z	2	1																																		
GBS1	Z	2								1																											
GBS1	Z	3	1																																		
GBS1	Z	3																						1	2												
GBS1	Z	3								1																											
GBS1	Z	3																						1	2											1	
GBS1	Z	3												1																						1	
GBS2	A	2																																			
GBS2	A	2																																			
GBS2	A	2																																			
GBS2	A	2																	1																		
GBS2	A	2																																			
GBS2	B	2								1																											
GBS2	B	2								1																											
GBS2	C	2			1																																
GBS2	C	2			1																																
GBS2	X	2								1																											
GBS2	Y	2																																			
GBS2	Y	2																											2							1	
GBS2	Y	3																											1						1		
GBS2	Y	3																																			
GBS2	Y	4	1																																		
GBS2	Z	2									1																										
GBS2	Z	2																		1					4												
GBS2	Z	2																									2										
GBS2	Z	3																									1										
GBS2	Z	3																						1	2												
GBS2	Z	3								1																											
GBS2	Z	3																										1									
GBS2	Z	4																																		71	
GBSH	B	1												1																							
GBSO	Z	2																									1										
GEGR	E	10									1																										
GEGR	E	10																		1					8												
GEGR	E	10																						1	2												
GEGR	E	10			1																																
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GEGR	E	10																								1											
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GEGR	E	10																						1	2												
GEGR	E	10								1																											
GEGR	E	10																		1					4												
GEGR	E	10																		1					3												SHREW
GEGR	E	10			1																																
GEGR	E	10												2																	4							
GEGR	E	10																		1					1												
GEGR	E	10																											7								
GEOB	F	8			1																																
GEOB	F	8																												1							
GEOB	F	8																		1					1												
GEOB	F	8																						1													
GEOB	F	8			1																																
GEOB	F	8																				1															
GEOB	F	8																											1								
GEOB	G	6																		1					2												
GLAC	Y	6																										1									
GLAC	Y	6																		1					1												
GLAC	Y	6							1																												
GLAC	Y	6																						1	1												
GLAC	Y	6							1																												
GNOM	X	4																		1					4.1												
GNOM	X	4																		1					2												

			FEMUR	FEMUR	FEMUR	FEMUR	TIBIA	TIBIA	TIBIA	TIBIA	HUMERUS	HUMERUS	HUMERUS	HUMERUS	RADIUS	RADIUS	ULNA	ULNA	CRANIAL	MANDIBLE	MANDIBLE	PREMAXILLA	PREMAXILLA	MAXILLA	DAMAGE	SINGLE	INCISOR	SINGLE	VERTEBRA	1/2-3/4	COMPLETE	PORTION OF	CLAVICLE	SCAPULA	SCAPULA	METAPODIAL	CALCANEUM &	
ACRONYM	SQUARE	NO	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	PROXIMAL	COMPLETE	PROXIMAL	FRAGMENT		FRAGMENT		FRAGMENT		CATEGORY	INCISORS	FRAG	MOLARS		VERTEBRA	INNOMINATE	INNOMINATE			FRAGMENT		ASTRAGALUS	COMMENTS
GNOM	X	4																								1												
GNOM	Y	4																																			1	
GNOM	Y	3																		1					3													
GONE	A	9																								1												
GONE	A	8	1																																			
GONE	A	6									1									1					1													
GONE	A	5			1																																	
GONE	A	1									1																											
GONE	A	1																		1					1							1						
GONE	B	8																																				
GONE	B	8			1						1																											
GONE	B	8					1													1					2													
GREL	B	5																		1					1		1											
GREL	B	5																										1										
GRLC	Y	6																								1												
GRLC	Y	6																		1					3													
GRLC	Y	5																		1					4													
GSBH	D	5																1																				
GSBH	D	5					1																															
GSBH	D	6								1										1					0													
GSBH	D	6							1															1	1													
GSFB																				1					1													
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GSFB	D	6																						1	1													
GSFB	D	6																						1	2													
GSFB	D	6				1																																
GSFB	F	4																								1												
HASH	Z	3																						1	2													
HASH	Z	3																						1	2													
HBDU	X	2								1																												
HBDU	X	4																														1						
HG1A	Z	8												1																								
HG1A	Z	6													1																							
HG1A	Z	6																1																				
HIAS	Y	4																												1								
HIBB	X	4									1																											
HIBB	X	4																		1					1													
HIBB	X	4																														1						
HIBB	Y	3												1												1												
HIPI	A	2																																				
HOBI	Y	8	1																									1										
HOBI	Z	8																										2										
HOBI	Z	8																								1										1		
HOBI	Z	6																										1										
HOBI	Z	8																		1					3													
HOBI	Z	6																														1						
HOBI	Z	6																		1					3													
HOBI	Z	5																														1						
HOCO																																						
HOCO								1																														
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HOCO																							1															
HOCO																																1						
HOLE	A	5																		1					1													
HOLE	A	8								1																												
HOLE	A	6																1																				
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HOLE	A	6																					1		1													
HOLE	A	6																		1					1													
HOLE	A	5																								1												
HOLE	A	5																										1										
HOLE	A	5							1																													L & R PREMAXILLA JOINED
HOLE	A	6																					1															L & R PREMAXILLA JOINED
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HOLE	A	6																		1					4,1													
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HOLE	A	6																		1					2													
HOLE	A	6																		1					2													

			FEMUR	FEMUR	FEMUR	FEMUR	TIBIA	TIBIA	TIBIA	TIBIA	HUMERUS	HUMERUS	HUMERUS	HUMERUS	RADIUS	RADIUS	ULNA	ULNA	CRANIAL	MANDIBLE	MANDIBLE	PREMAXILLA	PREMAXILLA	MAXILLA	DAMAGE	SINGLE	INCISIOR	SINGLE	VERTEBRA	1/2-3/4	COMPLETE	PORTION OF	CLAVICLE	SCAPULA	SCAPULA	METAPODIAL	CALCANEUM &	
ACRONYM	SQUARE	NO	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	PROXIMAL	COMPLETE	PROXIMAL	FRAGMENT		FRAGMENT		FRAGMENT		CATEGORY	INCISORS	FRAG	MOLARE		VERTEBRA	INNOMINATE	INNOMINATE			FRAGMENT		ASTRAGALUS	COMMENTS
HOLE	A	0																		1					2													
HOLE	A	0	1																																			
HOLE	A	0									1																											
HOLE	A	0																						1	2													
HOLE	A	0																									1											
HOLE	A	0																1								2						1						
HOLE	A	0																														1						
HOLE	A	0																														1						LR PREMAXILLA JOINED
HOLE	A	0																				1																
HOLE	A	0																										2				1						LR PREMAXILLA JOINED
HOLE	A	0																																				
HOLE	B	0																												2								
HOLE	B	0																											1									
HOLE	B	0																			71				3													
HOLE	B	0																		1					4,1													
HOLE	B	0																		1					1													
HOLE	B	0							1													1																
HOLE	B	0																																				
HOLE	B	0																				2				9												
HOLE	B	0																									6											
HOLE	B	0																														1						
HOLE	B	0																				1																
HOLE	B	0																		1					1													
HOLE	B	0																		1					3													SHIFTY
HOLE	B	0																		1					2													
HOLE	B	0																		1					1													
HOLE	B	0																		1					2													
HOLE	B	0																										1										
HOLE	B	0							1																													
HOLE	B	0																		1					1													
HOLE	B	0																		1					1													
HOLE	B	0																				1																
HOLE	B	0																						1	3													
HOLE	B	0																						2	2													
HOLE	B	0																														1						
HSOI	X	0																		1					1													
HSOI	X	0																		1							2											
HSOI	Z	0											1																									

ACRONYM	SQUARE	ND	FEMUR COMPLETE	FEMUR SHAFT	FEMUR PROXIMAL	FEMUR DISTAL	TIBIA COMPLETE	TIBIA SHAFT	TIBIA PROXIMAL	TIBIA DISTAL	HUMERUS COMPLETE	HUMERUS SHAFT	HUMERUS PROXIMAL	HUMERUS DISTAL	RADIUS COMPLETE	RADIUS PROXIMAL	ULNA COMPLETE	ULNA PROXIMAL	CRANIAL FRAGMENT	MANDIBLE	MANDIBLE FRAGMENT	PREMAXILLA	PREMAXILLA FRAGMENT	MAXILLA	DAMAGE CATEGORY	SINGLE INCISORS	INCISOR FRAG	SINGLE MOLARS	VERTEBRA	1/2-3/4 VERTEBRA	COMPLETE SYNSACRUM	PORTION OF SYNSACRUM	CLAVICLE	SCAPULA	SCAPULA FRAGMENT	METAPODIAL	CALCANEUM & ASTRAGALUS	COMMENTS
JANS	A	5																											1									
JANS	A	5																											1									
JANS	A	5																																				
JANS	A	5																											1									
JANS	A	5																								1												
JANS	A	5																								1												
JANS	A	5																											1									
JANS	A	5												1																								
JANS	A	5			1																																	
JANS	A	5			1																																	
JANS	A	5																												1								
JANS	B	5									1																											
JANS	B	5																				1																
JANS	B	5																											1									
JANS	B	5				1																																
JANS	B	5									1																											
JANS	B	5															1							1	2													
JANS	B	5																	1																			
JANS	B	5																						1	2													
JANS	B	5							1																													
JANS	B	5	1																											3								
JANS	B	5																								1												
JANS	B	5												1																								
JANS	B	5																				1																
JANS	B	5												1																2								
JANS	B	5																														1						
JANS	B	5																														1						
JANS	B	5								1																												
JANS	Z	5																								2												
JANS	Z	5																											1									
JANS	Z	5																		1					2													
JANS	Z	5																						1	1				1									
JANS	Z	5																				1																
JANS	Z	5																										1										
JANS	Z	5																				1																
JANS	Z	5																		1					2													
JANS	Z	5																		1				1	1													
JANS	Z	5								1																												
JECH	F	6																										1										
JECH	F	6																								1												
JECH	F	6																										1										
JECH	F	6																						1	1													
JECH	G	6													1																							
JECH	G	6												1																								
JECH	G	6																				1																
JECH	G	6																								2												
JECH	G	6																																	1			
JECH	G	7																											1									
JFR1														1					1																			
JFR1																													1									TOOTH IN #4 MICHE FRAG
JFR1																	1																					
JFR1														1																								
JFR1																													1									
JFR1	E	10																								1												
JFR1	E	10												71																								
JFR1	E	10																											1									
JFR1	F	5								1																												
JFR2	F	5																						1	1													
JFR2	F	5								1																												
JFR2	F	5																											1									
JFR2	F	5																		1					1													
JFR2	F	7&5									1																											
JFR2	F	7&5																						1	2													
JFR2	F	7&5																											1									
JHE		6																		1					1													
JHE		6																		1					1													
JHE		6																										1										
JHE		6																		1					1													
JHE		6																		1					1													
JHE	C	5										1																										
JHE	E	5																								1												
JHE	E	6							1																													
JHE	C	6															1																					
JMO	E	5																						1	1													
JMO	E	6																		1					1													
JOFR																															1							
JOFR										1																												
JOFR																													2									
JOFR														1											4													WHEW
JOFR					1																			1	2													
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JOFR									1									1																				
JOFR									1				1																									
JOFR																																		1				

ACRONYM	SQUARE	NO	FEMUR COMPLETE	FEMUR SHAFT	FEMUR PROXIMAL	FEMUR DISTAL	TIBIA COMPLETE	TIBIA SHAFT	TIBIA PROXIMAL	TIBIA DISTAL	HUMERUS COMPLETE	HUMERUS SHAFT	HUMERUS PROXIMAL	HUMERUS DISTAL	RADIUS COMPLETE	RADIUS PROXIMAL	ULNA COMPLETE	ULNA PROXIMAL	CRANIAL FRAGMENT	MANDIBLE	MANDIBLE FRAGMENT	PREMAXILLA	PREMAXILLA FRAGMENT	MAXILLA	DAMAGE CATEGORY	SINGLE INCISORS	INCISOR FRAG	SINGLE MOLARS	VERTEBRA	1/2-3/4 VERTEBRA	COMPLETE INNOMINATE	PORTION OF INNOMINATE	CLAVICLE	SCAPULA	SCAPULA FRAGMENT	METAPODIAL	CALCANEUM & ASTRAGALUS	COMMENTS
JOFR																												3										
JOFR																															3							
JOFR														1																									
JOFR																			3																		
JOFR							1																															
JOFR	C	8					1																															
JOFR	C	9																			1					1												
JOFR	C	9																												3								
JOFR	C	9							1																													
JOFR	C	9												1																								
JOFR	C	9																							1	1												
JOFR	C	8									1																											
JOFR	C	9																										2										
JOFR	C	9																			1					2												
JOFR	C	9				1																																
JOFR	C	9																													1							
JOFR	C	8																			1					1												
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JOFR	C	9																									3											
JOFR	C	9																			1					3												
JOFR	D	7										1																										
JOFR	D	8																										1										
JOFR	D	9																							1	1												
JOFR	D	8																			1					8												
JOFR	D	9									1																											
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JOFR	D	8																							1	1												
JOFR	D	9										1																										
JOFR	D	9																							1	1												
JOFR	D	9													1																							
JOFR	D	9																									4											
JOFR	D	9																									1											
JOFR	D	9																																					12 LONG BONE FRAGMENTS
JOFR	D	9																1																				
JOFR	D	8																												4								
JOFR	D	8																													3							
JOFR	D	9																	1																			
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			FEMUR	FEMUR	FEMUR	FEMUR	TIBIA	TIBIA	TIBIA	TIBIA	HUMERUS	HUMERUS	HUMERUS	HUMERUS	RADIUS	RADIUS	ULNA	ULNA	CRANIAL	MANDIBLE	MANDIBLE	PREMAXILLA	PREMAXILLA	MAXILLA	DAMAGE	SINGLE	INCISOR	SINGLE	VERTEBRA	1/2-3/4	COMPLETE	PORTION OF	CLAVICLE	SCAPULA	SCAPULA	METAPODIAL	CALCANEUM &	
ACRONYM	SQUARE	NO	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	PROXIMAL	COMPLETE	PROXIMAL	FRAGMENT		FRAGMENT		FRAGMENT		CATEGORY	INCISORS	FRAG	MOLARS		VERTEBRA	INNOMINATE	INNOMINATE			FRAGMENT		ASTRAGALUS	COMMENTS
JOFR	E	8																					1	2													
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JOFR	E	10																					1	2													
JOFR	E	10																					1	1													
JOFR	E	10			1																															
JOFR	E	10																											2								
JOFR	E	10																		1					2												
JOFR	E	10			1																															
JOFR	E	10																		1					4												
JOFR	E	10																										5									
JOFR	E	10																					1	3													
JOFR	E	10																							3											
JOFR	E	10																															2			
JOFR	E	10																		1					3												
JOFR	E	10	1																																	
JOFR	E	10																												1						
JOFR	E	10																									1									
JOFR	E	10																												1						
JOFR	E	10																												1						
JOFR	E	10																										12									
JOFR	E	10																												1						
JOFR	E	10								1																										
JOFR	E	10						1																												
JOFR	E	10																									1									
JOFR	E	10											1																								
JOFR	E	10											1																								
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JOFR	E	10									1																									
JOFR	E	10			1																															
JOFR	E	10											1																					1		
JOFR	E	10																												1						
JOFR	E	10																										16									
JOFR	E	10			1																															
JOFR	E	10																												1						
JOFR	E	10			1																															
JOFR	E	10											1																								
JOFR	E	10															1																				
JOFR	E	10																					1	1													
JOFR	E	10											1																								
JOFR	E	10											1																								
JOFR	E	10											1																								
JOFR	E	10																								2											
JOFR	E	10	1																																	
JOFR	E	10				1																														
JOFR	E	10											1																								
JOFR	E	10											1																								
JOFR	E	10			1																															
JOFR	E	10			1																															
JOFR	E	10											1																								
JOFR	E	10																												1						
JOFR	E	10																												1						
JOFR	E	10			1																															
JOFR	E	10																												1						
JOFR	E	10																					11	3													
JOFR	E	10			1																															
JOFR	E	10																4																			
JOFR	E	10																												1						
JOFR	E	10																	1					3													
JOFR	E	10											1																								

ACRONYM	SQUARE	NO	FEMUR COMPLETE	FEMUR SHAFT	FEMUR PROXIMAL	FEMUR DISTAL	TIBIA COMPLETE	TIBIA SHAFT	TIBIA PROXIMAL	TIBIA DISTAL	HUMERUS COMPLETE	HUMERUS SHAFT	HUMERUS PROXIMAL	HUMERUS DISTAL	RADIUS COMPLETE	RADIUS PROXIMAL	ULNA COMPLETE	ULNA PROXIMAL	CRANIAL FRAGMENT	MANDIBLE	MANDIBLE FRAGMENT	PREMAXILLA	PREMAXILLA FRAGMENT	MAXILLA	DAMAGE CATEGORY	SINGLE INCISORS	INCISOR FRAG	SINGLE MOLARS	VERTEBRA	1/2-3/4 VERTEBRA	COMPLETE INNOMINATE	PORTION OF INNOMINATE	CLAVICLE	SCAPULA	SCAPULA FRAGMENT	METAPODIAL	CALCANEUM & ASTRAGALUS	COMMENTS
JOFR	E	10																								1						1						
JOFR	E	10																																				
JOFR	E	10																						1	2													
JOFR	E	10				1																																
JOFR	F	7																								1												
JOFR	F	8																																		1			
JOFR	F	8			1																																	
JOFR	F	8																											2									
JOFR	F	8																								1												
JOFR	F	8																		1					5													
JOFR	F	10																		1					9													
JOFR	F	10																						1	1													
JOFR	F	10																		1					4													
JOFR	F	10																										2										
JOFR	F	10																						1	1													
JOFR	F	10																		1					6													bones
JOFR	F	10									1																											
JOFR	F	10												1																								
JOFR	F	10			1																																	
JOFR	F	10																		1					6													
JOFR	F	10									1																											
JOFR	F	10																1																				
JOFR	G	9																		1					2													
JOFR	G	9			1																																	
JOFR	G	9																								1												
JOFR	G	9																											1									
JUDO	X	6																						1	9													LARGE JUDO
JUDO	X	6																						1	9													LARGE JUDO
JUDO	Y	6																														1						
JUDO	Y	6																		1					4													
JUDO	Y	6			1																																	
JUDO	Y	6																						1	2													
JUDO	Y	6																		1					4													
JVOR	6/91																			1					4,1													
JVOR	6/91																							1	2													
JVOR	6/91																										1											
JVOR	C	2				1																																
JVOR	C	3												1																								
JVOR	C	3												1																								
KAMA	6/91																			1					3													
KAMA	6/91																			1					3													
KAMA	6/91																			1					5													
KAMA	6/91																							1	1													
KAMA	E	3												1																								
KAMA	D	4																		1					3,4													
KAMA	D	4																										1										
KAMA	E	5			1																																	
KAMA	E	5			1																																	
KAMA	E	5									1																											
KAMA	E	4							1																													
KAMA	E	4								1																												
KAMA	E	6									1																											
KAMA	F	6							1																													
KAMA	F	6	1																																			
KAMA	F	7				1																																
KARA	Y	6			1																																	
KARA	Y	6															1																					
KARA	Y	6																						1	1													
KARA	Y	6			1																																	
KARA	Y	6																		1					1													
KARA	Y	6																		1					2,4													ELEPHANT SHREW
KEKA	A	7																										1										
KEKA	A	7			1																																	
KEKA	A	7																								1												
KEKA	B	8								1																												
KEKA	Y	8																																				
KEKA	Y	8																								1												
KUPO	A	6												1																								
KUPO	B	6																								1												
LARM											1																											
LARM	C	7																										1										
LARM	C	7																						1	2													
LARM	C	7																		1					5													ELEPHANT SHREW
LARM	C	8																		1					4													
LARM	C	6																						1	2													
LARM	C	8																		1					2													
LARM	C	8																								1												
LARM	C	9																		1					5													
LARM	C	9																						1	2													
LARM	D	9																								1												
LARM	E	7								1																												
LARM	E	7												1																								
LARM	E	7																	1																			
LARM	E	7																								1												
LARM	E	7																						1	1													
LARM	E	7												1											5													
LARM	E	8												1											1													
LARM	F	8																											1									
LBED																												1									
LBED														1											9													
LBED	C	6																						1	1													
LBED	C	6												1											3													
LBED	C	6											1																									
LBED	C	6																											2									
LBED	C	6												1																								

ACRONYM	SQUARE	NO	FEMUR COMPLETE	FEMUR SHAFT	FEMUR PROXIMAL	FEMUR DISTAL	TIBIA COMPLETE	TIBIA SHAFT	TIBIA PROXIMAL	TIBIA DISTAL	HUMERUS COMPLETE	HUMERUS SHAFT	HUMERUS PROXIMAL	HUMERUS DISTAL	RADIUS COMPLETE	RADIUS PROXIMAL	ULNA COMPLETE	ULNA PROXIMAL	CRANIAL FRAGMENT	MANDIBLE	MANDIBLE FRAGMENT	PREMAXILLA	PREMAXILLA FRAGMENT	MAXILLA	DAMAGE CATEGORY	SINGLE INCISORS	INCISOR FRAG	SINGLE MOLARS	VERTEBRA	1/2-3/4 VERTEBRA	COMPLETE SYNOSTATE	PORTION OF SYNOSTATE	CLAVICLE	SCAPULA	SCAPULA FRAGMENT	METAPODIAL	CALCANEUM & ASTRAGALUS	COMMENTS
LBED	C	6																	2																				
LBED	C	6																																					
LBED	C	6																				1																	
LBED	C	6																						1	3														
LBED	C	6																								1													
LBED	C	6																										2											
LBED	C	6									1																												
LBED	C	6												1																									
LBED	C	6																																					
LBED	C	6				1																																	
LBED	C	6																																					
LBED	C	6																						1	2														
LBED	C	6																								2													
LBED	C	6						1																															
LBED	C	6																				1																	
LBED	C	6							1													1																	
LBED	C	6																																					
LBED	C	6								1																													
LEYA																																							
LGB1	A	6																						1	2														
LGB1	B	6																										1											
LGB1	B	4																								1													
LJAP	D	6												1																									
LMIP	D	6																																					
LMIP	A	4																		1					2				1										
LMIP	A	6																																					
LMIP	A	6	1																																				
LMIP	A	6																		1					1													
LMIP	A	6																																					
LMIP	B	3																		1					1			1										
LMIP	B	3																		1					1													
LMIP	B	3																		1					1													
LMIP	B	3	1																																				
LMIP	B	3																									1											
LMIP	B	3	1																																				
LMIP	B	4	1																																				
LMIP	B	4				1																																	
LMIP	B	4	1																																				
LMIP	B	4																																					
LMIP	B	6								1																													
LMIP	B	6																																					
LMIP	B	6																											1										
LMIP	B	6	1																																				
LZIG	Z	1																						1	1													
LZIG	Z	1																		1					1													
LZIG	Z	1																						1	1													
LZIG	Z	5																									1											
LZIG	Z	5																		1					2													
LZIG	Z	6																		1					1													
LZIG	Z	6																		1					3													
LZIG	Z	6																										1										
LZIG	Z	6																																					
LZIG	Z	6																				1																
LZIG	Z	6																									1											
LZIG	Z	6																																					
LZIG	Z	6						1																														1	
LZIG	Z	6								1																													
LMLE	D	7				1																																	
LMLE	D	7												1																									
LMLE	D	7																																					
LOBO	Z	1																																				1	
LOBO	Z	1						1																															
LOBO	Z	1									1																												
LOBO	Z	1									1																												
LOBO	Z	1								1																													
LOBS	A	5																																					
LOBS	A	5																																					
LOBS	A	5																		1					5													
LOBS	A	5								1																													
LOBS	A	5																									1											
LOBS	A	6																				1																
LOB6	A	7																						1	3													
LOB5	B	7																		1					1													
LOB5	B	7																						1	1													
LOB5	B	5																				1																
LOB5	B	5																						1	1													
LOB6	B	5																						1	1													
LOB5	B	5																				71						1										
LOB5	B	5																						1	1													
LOB5	B	5																																					
LOB5	B	5																								4												
LOB5	B	5																																					
LOB5	B	5				1																																	
LOB5	B	5																																					
LOG5	A	6						1																															
LOG5	A	6																								1												
LOG5	A	6						1																															
LOG5	A	6							1																														
LOG5	A	6								1																													
LOG5	A	6																																					
LOG5	A	6																		1					2													
LOG5	A	6																						1	2													

			FEMUR	FEMUR	FEMUR	FEMUR	TIBIA	TIBIA	TIBIA	TIBIA	HUMERUS	HUMERUS	HUMERUS	HUMERUS	RADIUS	RADIUS	ULNA	ULNA	CRANIAL	MANDIBLE	MANDIBLE	PREMAXILLA	PREMAXILLA	MAXILLA	DAMAGE	SINGLE	INCISOR	SINGLE	VERTEBRA	1/2-3/4	COMPLETE	PORTION OF	CLAVICLE	SCAPULA	SCAPULA	METAPODIAL	CALCANEUM &	
ACRONYM	SQUARE	ND	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	PROXIMAL	COMPLETE	PROXIMAL	FRAGMENT		FRAGMENT		FRAGMENT		CATEGORY	INCISORS	FRAG	MOLARS		VERTEBRA	INNOMINATE	INNOMINATE			FRAGMENT		ASTRAGALUS	COMMENTS
LOOS	A	9												1																								
LOOS	A	9																						1	2														
LOOS	A	0																											2										
LOOS	A	9	1																																				
LOOS	A	0																		1					2														
LOOS	A	0												1																									
LOOS	A	0																														1							
LOOS	B	9																		1					1														
LSBL	E	7												1																									
LSBL	E	8																									1												
LSBL	E	8																		1					2														
LSBL	E	8																											2										
LSBL	F	7	1																																				

			FEMUR	FEMUR	FEMUR	FEMUR	TIBIA	TIBIA	TIBIA	TIBIA	HUMERUS	HUMERUS	HUMERUS	HUMERUS	RADIUS	RADIUS	ULNA	ULNA	CRANIAL	MANDIBLE	MANDIBLE	PREMAXILLA	PREMAXILLA	MAXILLA	DAMAGE	SINGLE	INCISOR	SINGLE	VERTEBRA	1/2-3/4	COMPLETE	PORTION OF	CLAVICLE	SCAPULA	SCAPULA	METAPODIAL	CALCANEUS &	
ACRONYM	SQUARE	NO	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	PROXIMAL	COMPLETE	PROXIMAL	FRAGMENT		FRAGMENT		FRAGMENT		CATEGORY	INCISORS	FRAG	MOLARS		VERTEBRA	INNOMINATE	INNOMINATE			FRAGMENT		ASTRAGALUS	COMMENTS
MAGG	A	8	1																																			
MAGG	A	8					1																															
MAGG	A	8							1																													
MAGG	A	8					1																															
MAGG	A	8	1																																			
MAGG	A	8									1																											
MAGG	A	8																											3									
MAGG	A	8																													1							
MAGG	A	8									1																											
MAGG	B	8																		1					3													
MAGG	B	8									1																											
MAGG	B	8																														1						
MAJD	X	3	1																																			
MAJI	Y	2																			1																	L & R PREMAX JOINED
MAJI	Y	2																		1					8													
MAJI	Y	2																				1																
MAJI	Y	2																						1	1													
MAJI	Y	2																				1																
MAJI	Y	2																						1	1													
MAJI	Y	2																										2										
MAJI	Y	2																				1																
MAJI	Y	2																									3										
MAJI	Y	2																								1												
MAJI	Y	2																			1																	L & R PREMAX JOINED
MAJI	Y	7																		1					2													
MAJI	Y	7										1																											
MAJI	Y	7																								1												
MAJI	Z	7																		1					1													
MAJI	Z	7											1																										
MAJI	Z	7																		1					2													
MAJI	Z	7																		1					2,4													
MAJI	Z	7																									2											
MAJI	Z	7																											1									
MANT	Z	8							1																													
MANT	Z	A						1																														
MANT	Z	A																											1									
MANT	Z	A																						1	2													
MANT	Z	A																			71				3													
MARO	A	4																		1					4													
MARO	A	6						1																														
MARO	A	6										1																										
MARO	A	6																														1						
MARO	A	6						1																														
MARO	Z	5																											1									
MARO	Z	6																		1					1													
MARO	Z	6																														1						
MARO	Z	6																		1					3													
MARO	Z	6																						1					1									
MARO	Z	6																							1													
MARO	Z	6																		1					4													
MARO	Z	8																										1										
MARO	Z	8								1																												
MEJA																															1							
MEJA													1																										
MEJA	C	8	1																																			
MEJA	C	8																				1																L & R PREMAX & MAX JOINED
MEJA	C	8																				1		1	0													L & R PREMAX & MAX JOINED
MEJA	C	8																				1		1	8													L & R PREMAX & MAX JOINED
MEJA	C	8																				1																L & R PREMAX & MAX JOINED
MEJA	D	8																						1	2													
MEJA	D	8																								2												
MEJA	D	8																				1																
MEJA	E	6																																				
MEJA	E	8																	1																			
MEJA	F	8															1																					
MOBU	A	6				1																																
MOBU	A	6																										1										
MOBU	A	6							1																													
MOBU	A	6		1																																		
MOBU	A	6		1																																		
MOBU	A	6																											1									
MOBU	A	6																						1	2													
MOBU	A	6																						1	1													
MOBU	A	6									1																											
MOBU	A	6		1																																		
MOBU	A	7																						1	3													
MOBU	A	7																						1	2													
MOBU	A	7																		1					3													
MOBU	A	7																									1											
MOBU	A	7																										1										
MOBU	A	7				1																																
MOBU	A	7																								3												
MOBU	A	7																												3								
MOBU	A	7											1																										
MOBU	A	7																		1					4													

			FEMUR	FEMUR	FEMUR	FEMUR	TIBIA	TIBIA	TIBIA	TIBIA	HUMERUS	HUMERUS	HUMERUS	HUMERUS	RADIUS	RADIUS	ULNA	ULNA	CRANIAL	MANDIBLE	MANDIBLE	PREMAXILLA	PREMAXILLA	MAXILLA	DAMAGE	SINGLE	INCISIOR	SINGLE	VERTEBRA	1/2-3/4	COMPLETE	PORTION OF	CLAVICLE	SCAPULA	SCAPULA	METAPODIAL	CALCANEUM &	
ACRONYM	SQUARE	NO	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	PROXIMAL	COMPLETE	PROXIMAL	FRAGMENT		FRAGMENT		FRAGMENT		CATEGORY	INSCISORS	FRAG	MOLARS		VERTEBRA	INNOMINATE	INNOMINATE			FRAGMENT		ASTRAGALUS	COMMENTS
MOBU	A	7																	1																			
MOBU	D	7																						1	2														
MOBU	D	7																										1										
MOBU	D	7																						1	2													
MOBU	D	7							1																													
MOBU	D	7												1																								
MOBU	Z	7																								1												
MOBU	Z	7									1																											
MOBU	Z	7																		1					2													
MOS1	B	2												1																								
MOS1	B	2																						1	2													
MOS1	B	2																								1												
MOS1	D	2			1																																	
MOS1	D	2								1																												
MRSB	Y	6								1																												
MRSH	A	7													1																								
MRSH	A	7																		1					3													
MRSH	A	7																						1	1													
MRSH	A	7												1																								
MRSH	A	7																						1	2													
MRSH	A	7																									1											
MRSH	A	8																						1	2													
MRSH	B	7																		1					2													
MRSH	B	7																								1												
MRSH	B	7																						1	2													
MRSH	B	7																											1									
MRSH	B	7												1																								
MRSH	B	8																		1					1													
MRSH	B	9									1																											
MUSC	A	6																								1												
MUSC	A	6																					1															
MUSC	B	6																						1	1													
MUSO	Y	6	1																																			
MUSO	Y	6																		1					2													
MUSO	Y	6																						1	2													
MUSO	Y	6																								1												
MUSO	Y	6																									1											
MUSO	Y	6																		1					1													
MUSO	Y	6																				1																
MUSO	Z	6																		1					2													
MUSO	Z	6	1																																			
MUSO	Z	6																		1					1													
MUSO	Z	6																											2									
MUSO	Z	6			1																																	
MUSO	Z	6																		1					0													
MUSO	Z	6																		1					1													
MUSO	Z	6																		1					1													
MUSO	Z	6																		1					3													
NEFE	A	6									1																											
NEFE	A	6												6																								
NEFE	A	6																1																				
NEFE	A	6																						1	2													
NEFE	A	6																						1	2													
NEFE	A	6			1																																	
NEFE	A	6				71																																
NEFE	A	6			1																																	
NEFE	A	6										1																										
NEFE	A	6								1																												
NEFE	A	6																		1					1													
NEFE	A	6																		1					3													
NEFE	A	6																						71	3													
NEFE	A	6			1																																	
NEFE	A	6																		1					1													
NEFE	A	6																		1					4													
NEFE	A	6																										1										
NEFE	A	6																		1					3													
NEFE	A	6																		1					3													
NEFE	A	6												1																								
NEFE	A	6																1																				
NEFE	A	6																	6																			
NEFE	A	6																										1										SHREW
NEFE	A	6																		1					3													
NEFE	A	6																						1	2													
NEFE	A	6																						1	1													
NEFE	A	6																		1					2													
NEFE	A	6																		1					2													
NEFE	A	6																						1	2													
NEFE	A	6							1																													
NEFE	A	6																		1					1													
NEFE	A	6																		1					1													SHREW
NEFE	A	6																		1					4.3													
NEFE	A	6									1																											GOLDEN MOLE
NEFE	A	6								6																												
NEFE	A	6			1																																	
NEFE	A	6								1																												
NEFE	A	6																						1	3													
NEFE	A	6																		1					3													SHREW

ACRONYM	SQUARE	NO	FEMUR COMPLETE	FEMUR SHAFT	FEMUR PROXIMAL	FEMUR DISTAL	TIBIA COMPLETE	TIBIA SHAFT	TIBIA PROXIMAL	TIBIA DISTAL	HUMERUS COMPLETE	HUMERUS SHAFT	HUMERUS PROXIMAL	HUMERUS DISTAL	RADIUS COMPLETE	RADIUS PROXIMAL	ULNA COMPLETE	ULNA PROXIMAL	CRANIAL FRAGMENT	MANDIBLE	MANDIBLE FRAGMENT	PREMAXILLA	PREMAXILLA FRAGMENT	MAXILLA	DAMAGE CATEGORY	SINGLE INCISORS	INCISOR FRAG	SINGLE MOLARS	VERTEBRA	1/2-3/4 VERTEBRA	COMPLETE INNOMINATE	PORTION OF INNOMINATE	CLAVICLE	SCAPULA	SCAPULA FRAGMENT	METAPODIAL	CALCANEUM & ASTRAGALUS	COMMENTS
NEFE	A	8																						1	2													
NEFE	A	8																		1					1													
NEFE	A	8																										2										
NEFE	A	8																		1					1													
NEFE	A	8																		1					3													
NEFE	A	8																						1	1													
NEFE	A	8																		1					3													SHREW
NEFE	A	8												1																								
NEFE	A	8			1																																	
NEFE	A	8			1																																	
NEFE	A	8																		1					1													
NEFE	A	8			1																																	
NEFE	A	8																						1	2													
NEFE	A	8																						1	2													
NEFE	A	8																		1					1													
NEFE	A	8												1																								
NEFE	A	8																						1	2													
NEFE	A	8																							3,4													
NEFE	A	8																1																				
NEFE	A	8																									2											
NEFE	A	8																				3																
NEFE	A	8			1																											1						
NEFE	A	8																				6																
NEFE	A	8																		1					2													
NEFE	A	8																																				
NEFE	A	8																						1	3					8								
NEFE	A	8																																				
NEFE	A	8	1																																			
NEFE	A	8																														1						
NEFE	A	8																														1						
NEFE	A	8																		1					3													
NEFE	A	8						1																														
NEFE	A	8																		1					4,3													
NEFE	A	8																		1					3													
NEFE	A	8			2																																	
NEFE	A	8																		1					2													
NEFE	A	8																		1					4,3													
NEFE	A	8																											9									
NEFE	A	8																																				
NEFE	A	8											1																									
NEFE	A	8																						71														
NEFE	A	8																						1	2													
NEFE	A	8									1																											
NEFE	A	8																						72	3													
NEFE	A	8																						1	2													
NEFE	A	8																						1	2													
NEFE	A	8																						1	1													
NEFE	A	8																						1	2													
NEFE	A	8																						1	2													
NEFE	A	8												3																								
NEFE	A	8																														1						
NEFE	A	8																		1					3													
NEFE	A	8								2																												
NEFE	A	8																	7																			
NEFE	A	8																														1						
NEFE	A	8			3																																	
NEFE	A	8																									2											
NEFE	A	8																		1					3													
NEFE	A	8																						1	2													
NEFE	A	8																		1					4													
NEFE	A	8								1																												
NEFE	A	8																						1	3													
NEFE	A	8																										2										
NEFE	A	8			1																																	
NEFE	A	8			1																																	
NEFE	A	8								1																												
NEFE	A	8			1																																	

ACRONYM	SQUARS	NO	FEMUR COMPLETE	FEMUR SHAFT	FEMUR PROXIMAL	FEMUR DISTAL	TIBIA COMPLETE	TIBIA SHAFT	TIBIA PROXIMAL	TIBIA DISTAL	HUMERUS COMPLETE	HUMERUS SHAFT	HUMERUS PROXIMAL	HUMERUS DISTAL	RADIUS COMPLETE	RADIUS PROXIMAL	ULNA COMPLETE	ULNA PROXIMAL	CRANIAL FRAGMENT	MANDIBLE	MANDIBLE FRAGMENT	PREMAXILLA	PREMAXILLA FRAGMENT	MAXILLA	DAMAGE CATEGORY	SINGLE INCISORS	INCISOR FRAG	SINGLE MOLARS	VERTEBRA	1/2-3/4 VERTEBRA	COMPLETE INNOMINATE	PORTION OF INNOMINATE	CLAVICLE	SCAPULA	SCAPULA FRAGMENT	METAPODIAL	CALCANEUM & ASTRAGALUS	COMMENTS
NEFE	A	8																	1																			
NEFE	A	8											1																									
NEFE	A	8																		1					1													
NEFE	A	8																														1						
NEFE	A	8																						1	1													
NEFE	A	8				1																																
NEFE	A	8																																	2			
NEFE	A	8											2																									
NEFE	A	8																				1																
NEFE	A	8																														1						
NEFE	A	8																				3																
NEFE	A	8																						1	2													
NEFE	A	8																								12												
NEFE	A	8																														1						
NEFE	A	8																		1					3													
NEFE	A	8								1																												
NEFE	A	8																		1					1													
NEFE	A	8																		1					3													
NEFE	A	8																									1											
NEFE	A	8																		1					1													
NEFE	A	8																									2											
NEFE	A	8																1																				
NEFE	A	8																1																				
NEFE	A	8																		1					3													
NEFE	A	8				1																																
NEFE	A	8																2																				
NEFE	A	8																				1																
NEFE	A	8																		1					3													
NEFE	A	8																						1	2													
NEFE	A	8			2																																	
NEFE	A	8												1																								
NEFE	A	8																		1					2													
NEFE	Y	7						1																														
NEFE	Y	7																											1									
NEFE	Y	7												1																								
NEFE	Y	7																											1									
NEFE	Y	8																		1					3													
NEFE	Y	8			1																																	
NEFE	Y	8												1																								
NEFE	Y	8																		1					1													
NEFE	Y	8																									2											
NEFE	Y	8																					1															
NEFE	Y	8																	1																			
NEFE	Y	8																														1						
NEFE	Y	8																											2									
NEFE	Y	8																								2												
NEFE	Y	8																				1																
NEFE	Y	8																				1																
NEFE	Y	8																						1	2													
NEFE	Y	8																		1					4,3													
NEFE	Y	8								1																												
NEFE	Z	7																		1					1													
NEFE	Z	7																										4										
NEFE	Z	7																								2												
NEFE	Z	7																														1						
NEFE	Z	7																										1										
NEFE	Z	7																						1	1													
NEFE	Z	7																						1	0													L & R MAX JOINED
NEFE	Z	7																						1	1													
NEFE	Z	7																														1						
NEFE	Z	7																												1								
NEFE	Z	7																						1	2													
NEFE	Z	7			1																																	
NEFE	Z	7																										2										
NEFE	Z	7																		1					1													
NEFE	Z	7																		2					3													
NEFE	Z	7																	3																			
NEFE	Z	7								1																												
NEFE	Z	7							1																													
NEFE	Z	7																						1	1													
NEFE	Z	7																						1	1													
NEFE	Z	7																				1																
NEFE	Z	7																						1	3													
NEFE	Z	7																																				1 & 7 LONG BONE SHAFT
NEFE	Z	7									1																											
NEFE	Z	7											1																									
NEFE	Z	7												3																								
NEFE	Z	7												1																								
NEFE	Z	7						1																														
NEFE	Z	7																						1	1													
NEFE	Z	7																						1	0													L & R MAX JOINED
NEFE	Z	7																											6									
NEFE	Z	7																											2									
NEFE	Z	7																						1	1													
NEFE	Z	7																				1																
NEFE	Z	8																										2										
NEFE	Z	8																												12								
NEFE	Z	8																										3										

			FEMUR	FEMUR	FEMUR	FEMUR	TIBIA	TIBIA	TIBIA	TIBIA	HUMERUS	HUMERUS	HUMERUS	HUMERUS	RADIUS	RADIUS	ULNA	ULNA	CRANIAL	MANDIBLE	MANDIBLE	PREMAXILLA	PREMAXILLA	MAXILLA	DAMAGE	SINGLE	INCISOR	SINGLE	VERTEBRA	1/2-3/4	COMPLETE	PORTION OF	CLAVICLE	SCAPULA	SCAPULA	METAPODIAL	CALCANEUM &	
ACRONYM	SQUARE	NO	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	PROXIMAL	COMPLETE	PROXIMAL	FRAGMENT		FRAGMENT		FRAGMENT		CATEGORY	INCISORS	FRAG	MOLARS		VERTEBRA	INNOMINATE	INNOMINATE			FRAGMENT		ASTRAGALUS	COMMENTS
NEFE	Z	9																						1	2													
NEFE	Z	9																						1	1													
NEFE	Z	5																						1	2													
NEFE	Z	5						1																														
NEFE	Z	5																						1	1													
NEFE	Z	5																				4																
NEFE	Z	5																		1					1													
NEFE	Z	5								1																												
NEFE	Z	5																				6																
NEFE	Z	5																						1	1													
NEFE	Z	5																		1					1													
NEFE	Z	5																						1	3													SHREW
NEFE	Z	5																										1										
NEFE	Z	5										1																										
NEFE	Z	5																														1						
NEFE	Z	5																										4										
NEFE	Z	5																				1																
NEFE	Z	5																		1					1													
NEFE	Z	5																		1					3													
NEFE	Z	5																							3													
NEFE	Z	5																		1					2													
NEFE	Z	5																				1																
NEFE	Z	5			1																																	
NEFE	Z	5																		1					4,3													
NEFE	Z	5																		1					3													
NEFE	Z	5												5																								
NEFE	Z	5				1																																
NEFE	Z	5			1																																	
NEFE	Z	5																		1					4,3													
NEFE	Z	5																										3										
NEFE	Z	5																		1					3													
NEFE	Z	5																		1					1													
NEFE	Z	5			3																																	
NEFE	Z	5																						1	1													
NEFE	Z	5																																				
NEFE	Z	5																						1	1									3				
NEFE	Z	5																			71				3													
NEFE	Z	5																		1					1													
NEFE	Z	5																						1	2													
NEFE	Z	5																														1						
NEFE	Z	5																	1						3													
NEFE	Z	5																		1					2													
NEFE	Z	5																		1					2													
NEFE	Z	5									1																											
NEFE	Z	5																	3																			
NEFE	Z	5																		1					2													
NEFE	Z	5																		1					3													
NEFE	Z	5																						1														21 1 LONG BONE SHAFT
NEFE	Z	5																												8								
NEFE	Z	5																				1																
NEFE	Z	5																								16												
NEFE	Z	5																														1						
NEFE	Z	5								3																												
NEFE	Z	5																		1					3													
NEFE	Z	5																														1						
NEFE	Z	5												4																								
NEFE	Z	5								1																												
NEFE	Z	5								1																												
NEFE	Z	5																		1					2													
NEFE	Z	5					1																															
NEFE	Z	5																		1					4,3													
NEFE	Z	5									1																											
NEFE	Z	5			2																																	
NEFE	Z	5																														1						
NEFE	Z	5																		1					4													SHREW
NEFE	Z	5																				1																
NEFE	Z	5						1																														
NEFE	Z	5																														1						
NEFE	Z	5																		1					2,4													SHREW
NEFE	Z	5							1																													
NEFE	Z	5				1																																
NEFE	Z	5				1																																
NEFE	Z	5																		1					1													
NEFE	Z	5																						1	2													
NEFE	Z	5																				1																
NEFE	Z	5																						1	1													
NEFE	Z	5			1															1					4,3													

ACRONYM	SQUARE	NO	FEMUR COMPLETE	FEMUR SHAFT	FEMUR PROXIMAL	FEMUR DISTAL	TIBIA COMPLETE	TIBIA SHAFT	TIBIA PROXIMAL	TIBIA DISTAL	HUMERUS COMPLETE	HUMERUS SHAFT	HUMERUS PROXIMAL	HUMERUS DISTAL	RADIUS COMPLETE	RADIUS PROXIMAL	ULNA COMPLETE	ULNA PROXIMAL	CRANIAL FRAGMENT	MANDIBLE	MANDIBLE FRAGMENT	PREMAXILLA	PREMAXILLA FRAGMENT	MAXILLA	DAMAGE CATEGORY	SINGLE INSCISORS	INSCISOR FRAG	SINGLE MOLARS	VERTEBRA	1/2-3/4 VERTEBRA	COMPLETE INNOMINATE	PORTION OF INNOMINATE	CLAVICLE	SCAPULA	SCAPULA FRAGMENT	METAPODIAL	CALCANEUM & ASTRAGALUS	COMMENTS
NEFE	Z	9				1																																
NEFE	Z	9																		1					3													
NEFE	Z	9																		1					4,3													
NEFE	Z	9			1																																	
NEFE	Z	9																				1																L & R PREMAX & MAX JOINED, SHREW
NEFE	Z	9																						1	6													L & R PREMAX & MAX JOINED, SHREW
NEFE	Z	9																						1	2													
NEFE	Z	9																						1	2													
NEFE	Z	9																		1					3													SHREW
NEFE	Z	9																		1					2													
NEFE	Z	9																										3										SHREW
NEFE	Z	9																						1	6													L & R PREMAX & MAX JOINED, SHREW
NEFE	Z	9																			71				3													
NEFE	Z	9																		1					6													SHREW
NEFE	Z	9																						1	2													
NEFE	Z	9											1																									
NEFE	Z	9								1																												
NEFE	Z	9							1																													
NEFE	Z	9				1																																
NEFE	Z	9																																		1		
NEFE	Z	9																			71																	
NEFE	Z	9																										2										SHREW
NEFE	Z	9																				1																
NEFE	Z	9																										1										SHREW
NEFE	Z	9																										4										SHREW
NEFE	Z	9																								8												
NEFE	Z	9																														1						
NEFE	Z	9												1																								
NEFE	Z	9																												4								
NEFE	Z	9																						1	2													
NEFE	Z	9																										3										
NEFE	Z	9																									1											
NEFE	Z	9									1																											
NEFE	Z	9																						1	2													
NEFE	Z	9																								1												
NEFE	Z	9																											10									
NEFE	Z	9																						1	2													
NEFE	Z	9																						1	3													
NEFE	Z	9																						1	2													
NEFE	Z	9																						1	2													
NEFE	Z	9																		1					3													
NEFE	Z	9																																			2	
NEFE	Z	9				1																																
NEFE	Z	9																														2						
NEFE	Z	9																						1	2													
NEFE	Z	9																						1	2													
NEFE	Z	9															2																					
NEFE	Z	9																		1					2													
NEFE	Z	9																										3										
NEFE	Z	9																						1	2													
NEFE	Z	9																													1							
NEFE	Z	9																																				22 ? LONG BONE SHAFT
NEFE	Z	9												1																								
NEFE	Z	9																	6																			
NEFE	Z	9						2																														
NEFE	Z	9			1																																	
NEFE	Z	9																				1																L & R PREMAX & MAX JOINED, SHREW
NEFE	Z	9																		1					2													
NEFE	Z	9			1																																	
NEFE	Z	9																									2											
NEFE	Z	9			1																																	
NEFE	Z	9																		1					2													
NEFE	Z	9																		1					1													
NEFE	Z	9															1																					
NEFE	Z	9																														1						
NEFE	Z	9			71																																	
NEFE	Z	9												2																								
NEFE	Z	9																																	2			
NEFE	Z	9																														1						
NEFE	Z	9																		1					1													
NEFE	Z	9															3																					
NEFE	Z	9											1																									
NEFE	Z	9												1																								
NEFE	Z	9																				1																
NEFE	Z	9												1																								
NEFE	Z	9												1																								
NEFE	Z	9																				2																
NEFE	Z	9																		1					1													
NEFE	Z	9											1																									
NEFE	Z	9																														1						
NEFE	Z	9																														1						
NENY	8	6																						1	2													
NENY	8	6												1																								
NENY	8	6																											2									
NENY	8	6																						1	2													
NENY	8	6																						1	2													
NENY	Y	6																		1					1													
NENY	Y	6																				1																

			FEMUR	FEMUR	FEMUR	FEMUR	TIBIA	TIBIA	TIBIA	TIBIA	HUMERUS	HUMERUS	HUMERUS	HUMERUS	RADIUS	RADIUS	ULNA	ULNA	CRANIAL	MANDIBLE	MANDIBLE	PREMAXILLA	PREMAXILLA	MAXILLA	DAMAGE	SINGLE	INCISOR	SINGLE	VERTEBRA	1/2-3/4	COMPLETE	PORTION OF	CLAVICLE	SCAPULA	SCAPULA	METAPODIAL	CALCANEUM &	
ACRONYM	SQUARE	NO	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	PROXIMAL	COMPLETE	PROXIMAL	FRAGMENT		FRAGMENT		FRAGMENT		CATEGORY	INCISORS	FRAG	MOLARS		VERTEBRA	INNOMINATE	INNOMINATE			FRAGMENT		ASTRAGALUS	COMMENTS
NENY	Y	6																		1					2													
NENY	Y	6								1																													
NENY	Y	6																								1													
NENY	Y	6																	1																				
NENY	Y	6																											1										
NEPT	A	4																		1					2														
NEPT	A	4																									1												
NEPT	A	4																										2											
NEPT	A	4																		1					1														
NEPT	A	4																		1					1														
NEPT	A	4																								1													
NEPT	A	4	1																																				
NEPT	A	4																		1					3														
NEPT	A	4																														1							
NEPT	A	4																				1																	
NEPT	A	4																		1					2														
NEPT	A	4							1																														
NEPT	A	5																						1	2							1							
NEPT	A	5									1																												
NEPT	A	5								1																													
NEPT	B	2																				1																	
NEPT	B	2																1									1												
NEPT	B	2				1																																
NEPT	B	2																				1																	
NEPT	B	2																														1							
NEPT	B	3	1																																				
NEPT	B	3																									1												
NEPT	B	4																				1																	L & R PREMAX JOINED
NEPT	B	4																				1																	L & R PREMAX JOINED
NEPT	B	4								1																													
NEPT	B	4																		1					1														
NEPT	B	4																									2												
NEPT	B	6																						1	2														
NEPT	B	6																1																					
NEPT	B	6																		1					1														
NEPT	B	6																										1											
NEPT	B	6																								1													
NEPT	B	6					1																																
NEPT	X	4																						1	2														
NEPT	X	4																		1					1														
NEPT	Y	4																								1													
NEPT	Z	3											1	?																									
NEPT	Z	3												1																									
NEPT	Z	3																						1	1														
NEPT	Z	3																		1					1														
NEPT	Z	4								1																													
NEPT	Z	6																								1													SHREW
NERD	A	6																										2											SHREW
NERD	A	6				1																																	
NERD	Z	6														1																							
NERD	Z	6			1																																		
NERD	Z	6																																					LT LONG BONE SHAFT
NERD	Z	6									1																												
NETO	W	6								1																													
NIXO																																1							
NIXO																																				1			
NIXO					1																																		
NIXO					1																																		
NIMO	Y	7			1																																		
NIMO	Y	7																								1													
NIMO	Y	7																						1	1														
NIMO	Y	7																										2											
NIMO	Z	6											1																										
NIMO	Z	8																								1													
NIMO	Z	8																												1									
NIMO	Z	8																						71	3														
NIMO	Z	8																				1																	
NIMO	Z	8			1																																		
NIMO	Z	8																								1													
NIMO	Z	8																											2										
NIMO	Z	8			1																																		
NIXON	A	8									1																												
NIXON	A	8																		1					1														
NIXON	A	8																		1					2														
NIXON	A	8																																					
NIXON	A	8																				1					1												
NIXON	A	8																		1					2														
NIXON	A	8																		1					1														
NIXON	A	8						1														1																	
NIXON	A	9								1																													
NIXON	B	5																												3									
NIXON	B	5																																				1	
NIXON	B	6																								1													
NIXON	B	9																		1					2														SHREW
NIXON	B	9																												1									

ACRONYM	SQUARE	NO	FEMUR COMPLETE	FEMUR SHAFT	FEMUR PROXIMAL	FEMUR DISTAL	TIBIA COMPLETE	TIBIA SHAFT	TIBIA PROXIMAL	TIBIA DISTAL	HUMERUS COMPLETE	HUMERUS SHAFT	HUMERUS PROXIMAL	HUMERUS DISTAL
NKOM	Y	8												
NUIS	B	6												1
NUIS	B	6												
NUIS	B	6												
NUIS	B	6						1						
NUIS	B	6								1				
NUIS	B	6	1											
NUIS	B	6								1				
NUIS	B	6												
NUIS	B	6												
NUIS	B	6												
NUIS	B	6												
NUIS	B	6												
NYER														
NYER														
NYER			1											
NYER														
NYER														
NYER														
NYER	A	1			1									
NYER	A	1												
NYER	A	1												
NYER	A	1												
NYER	A	1												
NYER	A	4												
NYER	A	4												
NYER	A	4												
NYER	A	4												
NYER	A	6												
NYER	A	6												
NYER	A	6												
NYER	A	6												
NYER	A	6			1									
NYER	A	6												
NYER	A	6												
NYER	A	6												
NYER	A	6												
NYER	A	6												
NYER	A	6			1									
NYER	A	6												
NYER	A	6												
NYER	A	6			1									
NYER	A	6												
NYER	A	6			1									
NYER	A	6												
NYER	A	6												1
NYER	A	6												
NYER	A	6												
NYER	A	6			1									
NYER	A	6												
NYER	A	6									1			
NYER	A	6			1									
NYER	A	6					1							
NYER	A	6												
NYER	A	6												
NYER	A	6											1	
NYER	A	6												
NYER	A	6												
NYER	A	6												
NYER	A	6						1						
NYER	A	6												
NYER	A	6												
NYER	A	6												
NYER	A	6												
NYER	A	6												
NYER	A	6												
NYER	B	6												
NYER	B	6												
NYER	B	6												
NYER	B	6												
NYER	B	6												
NYER	B	4												
NYER	B	6												
NYER	B	6												
NYER	B	6												
NYER	B	6												
NYER	B	6				1								
NYER	B	6				1								
NYER	B	6												
NYER	B	6												
NYER	B	6						1						
NYER	B	7												
NYER	B	7												
NYER	B	7												
NYER	Z	6												
NYER	Z	6												
NYER	Z	6												
NYER	Z	6												

ACRONYM	SQUARE	NO	RADIUS COMPLETE	RADIUS PROXIMAL	ULNA COMPLETE	ULNA PROXIMAL	CRANIAL FRAGMENT	MANDIBLE	MANDIBLE FRAGMENT	PREMAXILLA	PREMAXILLA FRAGMENT	MAXILLA	DAMAGE CATEGORY	SINGLE INSCISORS
NKOM	Y	8												
NUIS	B	6												
NUIS	B	6						1					1	
NUIS	B	6								1				
NUIS	B	6												
NUIS	B	6												
NUIS	B	6												
NUIS	B	6												
NUIS	B	6												
NUIS	B	6										1	2	
NUIS	B	6								1				
NUIS	B	6										1	2	
NUIS	B	6						1					1	
NYER												1	1	
NYER														
NYER														
NYER												1	1	
NYER														
NYER														
NYER	A	1												
NYER	A	1										1	2	
NYER	A	1												
NYER	A	1					1							
NYER	A	1												2
NYER	A	4								1				
NYER	A	4												2
NYER	A	4						1					3	
NYER	A	4						1					0	
NYER	A	6												1
NYER	A	6												
NYER	A	6				1								
NYER	A	6								1				
NYER	A	6												
NYER	A	6					2							
NYER	A	6												1
NYER	A	6										1	2	
NYER	A	6						1					3	
NYER	A	6				1								
NYER	A	6												
NYER	A	6						1					2	
NYER	A	6										1	3	
NYER	A	6												
NYER	A	6												
NYER	A	6												
NYER	A	6										1	2	
NYER	A	6												
NYER	A	6												
NYER	A	6						1					4,3	
NYER	A	6												
NYER	A	6												3
NYER	A	6												
NYER	A	6												
NYER	A	6												
NYER	A	6										1	2	
NYER	A	6						1					4,3	
NYER	A	6												
NYER	A	6										1	2	
NYER	A	6												
NYER	A	6												
NYER	A	6												
NYER	A	6												
NYER	A	6						1					0	
NYER	A	6						1					2	
NYER	A	6												
NYER	A	6												1
NYER	A	6												
NYER	B	6												
NYER	B	6	1											
NYER	B	6												
NYER	B	6												1
NYER	B	6										1	2	
NYER	B	4												
NYER	B	6												
NYER	B	6										1	2	
NYER	B	6					1							
NYER	B	6												
NYER	B	6												
NYER	B	6												
NYER	B	6												1
NYER	B	6												
NYER	B	6												
NYER	B	7												
NYER	B	7												
NYER	B	7										1	2	
NYER	Z	6								1				
NYER	Z	6												1
NYER	Z	6												
NYER	Z	6						1					2	

ACRONYM	SQUARE	NO	INSCISOR FRAG	SINGLE MOLARS	VERTEBRA	1/2-3/4 VERTEBRA	COMPLETE INNOMINATE	PORTION OF INNOMINATE	CLAVICLE	SCAPULA	SCAPULA FRAGMENT	METAPODIAL	CALCANEUM & ASTRAGALUS	COMMENTS
NKOM	Y	8			1									
NUIS	B	6												
NUIS	B	6												
NUIS	B	6												
NUIS	B	6												
NUIS	B	6												
NUIS	B	6												
NUIS	B	6												
NUIS	B	6	1											
NUIS	B	6												
NUIS	B	6												
NUIS	B	6												
NUIS	B	6												
NYER														
NYER														1X 1 LONG BONE SHAFT
NYER														
NYER														
NYER					1									
NYER				4										
NYER	A	1												
NYER	A	1												
NYER	A	1		2										
NYER	A	1												
NYER	A	1												
NYER	A	4												
NYER	A	4												
NYER	A	4												
NYER	A	4												
NYER	A	6												
NYER	A	6			1									
NYER	A	6												
NYER	A	6												
NYER	A	6												
NYER	A	6												
NYER	A	6												
NYER	A	6												
NYER	A	6												
NYER	A	6												
NYER	A	6												
NYER	A	6												
NYER	A	6												
NYER	A	6												
NYER	A	6						1						
NYER	A	6												
NYER	A	6												
NYER	A	6												
NYER	A	6												
NYER	A	6												
NYER	A	6												
NYER	A	6												
NYER	A	6												
NYER	A	6												
NYER	A	6												
NYER	A	6												
NYER	A	6												
NYER	A	6												
NYER	A	6												
NYER	A	6						1						
NYER	A	6			2									
NYER	A	6												
NYER	A	6									1			
NYER	A	6												
NYER	A	6												
NYER	A	6	1											
NYER	A	6												
NYER	A	6		1										
NYER	B	6	1											
NYER	B	6												
NYER	B	6			1									
NYER	B	6												
NYER	B	6												
NYER	B	4		1										
NYER	B	6		1										
NYER	B	6												
NYER	B	6												
NYER	B	6						1						
NYER	B	6												
NYER	B	6												
NYER	B	6												
NYER	B	6												1X 1 LONG BONE SHAFT
NYER	B	6												
NYER	B	7		1										
NYER	B	7			1									
NYER	B	7												
NYER	Z	6												
NYER	Z	6												
NYER	Z	6											1	
NYER	Z	6												

			FEMUR	FEMUR	FEMUR	FEMUR	TIBIA	TIBIA	TIBIA	TIBIA	HUMERUS	HUMERUS	HUMERUS	HUMERUS	RADIUS	RADIUS	ULNA	ULNA	CRANIAL	MANDIBLE	MANDIBLE	PREMAXILLA	PREMAXILLA	MAXILLA	DAMAGE	SINGLE	INCISOR	SINGLE	VERTEBRA	1/2-3/4	COMPLETE	PORTION OF	CLAVICLE	SCAPULA	SCAPULA	METAPODIAL	CALCANEUM &	
ACRONYM	SQUARE	NO	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	PROXIMAL	COMPLETE	PROXIMAL	FRAGMENT		FRAGMENT		FRAGMENT		CATEGORY	INCISORS	FRAG	MOLARS		VERTEBRA	INNOMINATE	INNOMINATE			FRAGMENT		ASTRAGALUS	COMMENTS
NYER	Z	6																									2											
NYER	Z	7																										2										
NYER	Z	7												1																								
NYER	Z	7																														1						
NYER	Z	7											1																									
NYER	Z	7												1																								
NYER	Z	7																		1					2													
NYER	Z	7																						1	2													
NYER	Z	7					1																															
NYER	Z	7																		1					1													
NYER	Z	7																								1												
NYER	Z	7																		1					2													
NYER	Z	7																								1												
NYER	Z	7				1																																
OBOT	A	7																										7										
OBOT	A	7																											6									
OBOT	A	7																						1	3													
OBOT	A	7				1																																
OBOT	A	7																		1					3													
OBOT	A	7																	3																			
OBOT	A	7																									1											
OBOT	A	7								1																												
OBOT	A	7																								7												
OBOT	A	7																		1					3													
OBOT	A	7																						1	2													
OBOT	A	7																						1	3													
OBOT	A	7																												2								
OBOT	A	7																						1	2													
OBOT	A	7																				1																
OBOT	A	7												1																								
OBOT	A	7																				1																
OBOT	A	7																								1												
OBOT	A	7																				1																
OBOT	A	7																												1								
OBOT	A	7																		1					3													
OBOT	A	7								1																												
OBOT	A	7																											1									
OBOT	A	7																														1						
OBOT	A	7																		1					3													
OBOT	A	7																						1	3													
OBOT	A	7																						1	2													
OBOT	A	7			1																																	
OBOT	A	7																						1	1													
OBOT	A	7																						1	1													
OBOT	A	7																		1					4													
OBOT	A	7																						1	3													
OBOT	A	7																														1						
OBOT	A	7												1																								
OBOT	A	7																																				34 LONG BONE SHAFT FRAGMENTS
OBOT	A	7												1																								
OBOT	A	7																																	1			
OBOT	A	7																														1						
OBOT	A	7								1																												
OBOT	A	7												1																								
OBOT	A	7				1																																
OBOT	A	7								1																												
OBS1																														1								
OBS1																				1					1													
OBS1																												2										
OBS1	A	2							1																													
OBS1	C	2												1																								
OBS1	H	2																																	1			
OBS1	Y	2																				1																
OBS1	Z	2																																				
OBS1	Z	2															1																					
OBS1	Z	2																											1									
OBS1	Z	3																		1					4,3													
OBS1	Z	4																																				
OBS1	Z	4							1																													
OBS1	Z	4								1																												
OBS1	Z	8																											1									
OBS2																								1	2													
OBS2	A	2								1																												
OBS2	A	2																		1					1													
OBS2	B	2			1																																	
OBS2	D	2																											1									
OBS2	D	2																																			1	
OBS2	D	2																											1									
OBS2	Y	3																																			1	
OBS2	Y	4												1																								
OBS2	Z	4																								1												
OBS2	Z	4												1																								
OBS2	Z	4																												1								
OBS2	Z	6																												1								
OBS2	Z	6																																				
OBS2	Z	6																																				
OBS2	Z	6																																				
OBS2	Z	8																																		1		

			FEMUR	FEMUR	FEMUR	FEMUR	TIBIA	TIBIA	TIBIA	TIBIA	HUMERUS	HUMERUS	HUMERUS	HUMERUS	RADIUS	RADIUS	ULNA	ULNA	CRANIAL	MANDIBLE	MANDIBLE	PREMAXILLA	PREMAXILLA	MAXILLA	DAMAGE	SINGLE	INCISOR	SINGLE	VERTEBRA	1/2-3/4	COMPLETE	PORTION OF	CLAVICLE	SCAPULA	SCAPULA	METAPODIAL	CALCANEUM &	
ACRONYM	SQUARE	NO	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	PROXIMAL	COMPLETE	PROXIMAL	FRAGMENT		FRAGMENT		FRAGMENT		CATEGORY	INCISORS	FRAG	MOLARS		VERTEBRA	INNOMINATE	INNOMINATE			FRAGMENT		ASTRAGALUS	COMMENTS
QBETV2	Y	2																														1						
QRCO	X	4															1																					
QXYO	B	0								1																												
QXYO	B	0	1																																			
QXYO	B	0			1																																
QXYO	B	0																														1						
QXYO	B	0																		1					0													
QXYO	B	0									1																											GOLDEN MOLE
QXYO	B	0																		1					1													
QXYO	B	0			1																																	
PARO	A	1						1																														
PARO	A	3				1																																
PARO	A	3																								1								1				
PARO	A	3																																1				
PARO	A	3																	1																			
PARO	A	3																		1					1													
PARO	A	3																		1					0													
PARO	B	2															1									1												
PARO	B	2																																				
PBQB	C	6	1																	1					2				1									
PBQB	C	6																										1										
PBQB	D	4																																				
PELE																									1													
PELE																									1													
PELE																				1					1													
PELE																				1					1													
PELE																				1					1													
PELE																								1	1													
PELE																				1					3													
PELE	B	5															1																					
PELE	C	2																												1								
PELE	C	2																								1												
PELE	C	2																						1	1													
PELE	C	7								1																												
PELE	C	7																		1					1													
PELE	C	7								1																												
PELE	C	7																								1												
PELE	C	7																						1	1													
PELE	C	7																		1					1													
PELE	C	7																		1					1													
PELE	D	3	1																																			
PELE	D	3																		1					3													
PELE	D	3																		1					1													
PELE	D	3	1																																			
PELE	D	3																																				
PELE	D	3	1																																			
PELE	D	3				1																				1												
PELE	D	3																		1					2													
PELE	D	3																									2											
PELE	D	3	1																																			
PELE	D	3																		1					1													
PELE	D	3																		1					2													
PELE	D	3									1																											
PELE	D	4																														1						
PELE	D	4												1																								
PELE	D	4					1																															
PELE	D	4			1																																	
PELE	E	3			1																																	
PELE	E	4																							1	1												
PELE	E	6								1																												
PELE	E	6									1																											
PELE	E	6								1																												
PELE	E	6												1																								
PELE	E	6			1																																	
PGROPG	Y	0																												1								
PGROPG	Y	0																			1																	
PGROPG	Y	0															1																					
PGROPG	Y	0																																		1		
PGROPG	Y	0								1																												
PGROPG	Y	0									1																											
PGROPG	Y	0																												1								
PGROPG	Y	0			1																																	
PGROPG	Y	0																								1												
PGROPG	Y	0																							71													
PGROPG	Y	0			1																																	
PGROPG	Y	0																							1													
PGROPG	Y	0												1																								
PGROPG	Y	0																														1						
PGROPG	Y	0																								1												
PNL	Y	6							1																													
PLAS											1																											
PLAS	E	4																											1									
PLAS	Z	4												1																								
PNR	H	6																		1					3													
PNR	X	3																														1						
PNER	6/91																			1					1													
PNER	6/91																			1					1													

			FEMUR	FEMUR	FEMUR	FEMUR	TIBIA	TIBIA	TIBIA	TIBIA	HUMERUS	HUMERUS	HUMERUS	HUMERUS	RADIUS	RADIUS	ULNA	ULNA	CRANIAL	MANDIBLE	MANDIBLE	PREMAXILLA	PREMAXILLA	MAXILLA	DAMAGE	SINGLE	INSCISOR	SINGLE	VERTEBRA	1/2-3/4	COMPLETE	PORTION OF	CLAVICLE	SCAPULA	SCAPULA	METAPODIAL	CALCANEUM &	
ACRONYM	SQUARE	NO	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	PROXIMAL	COMPLETE	PROXIMAL	FRAGMENT		FRAGMENT		FRAGMENT		CATEGORY	INSCISORS	FRAG	MOLARS		VERTEBRA	INNOMINATE	INNOMINATE			FRAGMENT		ASTRAGALUS	COMMENTS
PKER	6/91																					1																	
PKER	6/91																									1													
PKER	E	4																											1										
POTA	X	1																																			1		
POTA	X	1																																			1		
PSEI	A	4																						1	2														
PSEI	A	4																		1					1														
PSEI	A	4					1																																
PSEI	A	4								1																													
PSEI	A	4																														1							
PWSO	A	3																						1	2														
PWSO	A	3								1																													
PWSO	A	5															1																						
PWSO	B	3			1																																		
PWSO	Z	1																											1										
PWSO	Z	5								1																													
PWSO	Z	5								1																													
PWSO	Z	6								1																													

ACRONYM	SQUA	NO	FEMUR COMPLETE	FEMUR SHAFT	FEMUR PROXIMAL	FEMUR DISTAL	TIBIA COMPLETE	TIBIA SHAFT	TIBIA PROXIMAL	TIBIA DISTAL	HUMERUS COMPLETE	HUMERUS SHAFT	HUMERUS PROXIMAL	HUMERUS DISTAL	RADIUS COMPLETE	RADIUS PROXIMAL	ULNA COMPLETE	ULNA PROXIMAL	CRANIAL FRAGMENT	MANDIBLE	MANDIBLE FRAGMENT	PREMAXILLA	PREMAXILLA FRAGMENT	MAXILLA	DAMAGE CATEGORY	SINGLE INCISORS	INCISOR FRAG	SINGLE MOLARS	VERTEBRA	1/2-3/4 VERTEBRA	COMPLETE INNOMINATE	PORTION OF INNOMINATE	CLAVICLE	SCAPULA	SCAPULA FRAGMENT	METAPODIAL	CALCANEUM & ASTRAGALUS	COMMENTS
RADS	Y	7																											3									
RADS	Y	8																				1																LEFT AND RIGHT PREMAXILLA JOINED
RADS	Y	8																				1																
RADS	Y	8																				1																
RADS	Y	8																									2											
RADS	Y	8																				1																LEFT AND RIGHT PREMAXILLA JOINED
RADS	Y	8																										1									
RADS	Y	8																						1	1													
RADS	Y	8																						1	1													
RADS	Y	8																																			1	
RADS	Z	7																						1	1													
RADS	Z	7																		1					2													
RADS	Z	7																										1									
RADS	Z	7																									1										
RADS	Z	8																								3											
RADS	Z	9																						1	1													
RADS	Z	9																		1					1													
RADS	Z	9																				1																
RADS	Z	9																						1	1													
RADS	Z	9			1																																	
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REAR	B	9																						1	1													

			FEMUR	FEMUR	FEMUR	FEMUR	TIBIA	TIBIA	TIBIA	TIBIA	HUMERUS	HUMERUS	HUMERUS	HUMERUS	RADIUS	RADIUS	ULNA	ULNA	CRANIAL	MANDIBLE	MANDIBLE	PREMAXILLA	PREMAXILLA	MAXILLA	DAMAGE	SINGLE	INCISOR	SINGLE	VERTEBRA	1/2-3/4	COMPLETE	PORTION OF	CLAVICLE	SCAPULA	SCAPULA	METAPODIAL	CALCANEUM &	
ACRONYM	SQUA	NO	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	PROXIMAL	COMPLETE	PROXIMAL	FRAGMENT		FRAGMENT		FRAGMENT		CATEGORY	INCISORS	FRAG	MOLARS		VERTEBRA	INNOMINATE	INNOMINATE			FRAGMENT		ASTRAGALUS	COMMENTS
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RHIN	Y	4																												1						
RHIN	Y	4																					1	2												
RHIN	Y	6			1																															

			FEMUR	FEMUR	FEMUR	FEMUR	TIBIA	TIBIA	TIBIA	TIBIA	HUMERUS	HUMERUS	HUMERUS	HUMERUS	RADIUS	RADIUS	ULNA	ULNA	CRANIAL	MANDIBLE	MANDIBLE	PREMAXILLA	PREMAXILLA	MAXILLA	DAMAGE	SINGLE	INCISOR	SINGLE	VERTEBRA	1/2-3/4	COMPLETE	PORTION OF	CLAVICLE	SCAPULA	SCAPULA	METAPODIAL	CALCANEUM &	
ACRONYM	SQUA	NO	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	PROXIMAL	COMPLETE	PROXIMAL	FRAGMENT		FRAGMENT		FRAGMENT		CATEGORY	INCISORS	FRAG	MOLARS		VERTEBRA	INNOMINATE	INNOMINATE				FRAGMENT		ASTRAGALUS	COMMENTS
RING	V	6																											1							1		
RING																													1									
RING	2/92																							71	2													
RING	2/92				1																																	
RING	6/91																			1					8													
RING	6/91																					1																
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RING	E	6																			71																		
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RING	E	6					1																																
RING	E	6								1																													
JENO	E	6																								3													
RING	E	6																								1													
RING	E	6																		1					4														SHREW
RING	F	6												1																									
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ROBE	Z	7							1																														
ROBE	Z	7																																					
ROBE	Z	7			1																																		
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SAMO	A	8																																					
SAMO	A	8																																					
SAMO	A	8																																					
SASO	X	2																																					
SASO	X	2																																					
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SASO	X	3																																					LEFT AND RIGHT PREMAXILLA JOINED
SASO	X	3																																					
SASO	X	3				1																																	
SAVI	Z	7												1																									
SCRA	A	8																																					
SCRA	C	7																																					
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SCRA	Y	8																																					
SDUN	C	9																																					
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SDUN	C	9																																					
SDUN	C	9				1																																	
SDUN	C	9			1																71				4,3														
SDUN	C	9																																					
SDUN	D	9																																					
SDUN	D	9																		1					2														
SECTION C	A	2							1											1					2														
SECTION C	A	2																																					
SEKH	Z	7																								1													
SEKH	Z	7			1																																		
SEMO	Y	7																																		1			
SEMO	Y	8																		1					2														
SEMO	Y	8																									1												

			FEMUR	FEMUR	FEMUR	FEMUR	TIBIA	TIBIA	TIBIA	TIBIA	HUMERUS	HUMERUS	HUMERUS	HUMERUS	RADIUS	RADIUS	ULNA	ULNA	CRANIAL	MANDIBLE	MANDIBLE	PREMAXILLA	PREMAXILLA	MAXILLA	DAMAGE	SINGLE	INCISOR	SINGLE	VERTEBRA	1/2-3/4	COMPLETE	PORTION OF	CLAVICLE	SCAPULA	SCAPULA	METAPODIAL	CALCANEUM &	
ACRONYM	SQUA	NO	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	PROXIMAL	COMPLETE	PROXIMAL	FRAGMENT		FRAGMENT		FRAGMENT		CATEGORY	INCISORS	FRAG	MOLARS		VERTEBRA	INNOMINATE	INNOMINATE				FRAGMENT		ASTRAGALUS	COMMENTS
SENQ	Y	8																										1				1							
SENQ	Y	8																										1											
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SHAK	A	6																									1											
SHAK	A	8										1																											
SHAK	A	8																										3											

ACRONYM	SQUA	NO	FEMUR COMPLETE	FEMUR SHAFT	FEMUR PROXIMAL	FEMUR DISTAL	TIBIA COMPLETE	TIBIA SHAFT	TIBIA PROXIMAL	TIBIA DISTAL	HUMERUS COMPLETE	HUMERUS SHAFT	HUMERUS PROXIMAL	HUMERUS DISTAL	RADIUS COMPLETE	RADIUS PROXIMAL	ULNA COMPLETE	ULNA PROXIMAL	CRANIAL FRAGMENT	MANDIBLE	MANDIBLE FRAGMENT	PREMAXILLA	PREMAXILLA FRAGMENT	MAXILLA	DAMAGE CATEGORY	SINGLE INCISORS	INCISOR FRAG	SINGLE MOLARS	VERTEBRA	1/2-3/4 VERTEBRA	COMPLETE INNOMINATE	PORTION OF INNOMINATE	CLAVICLE	SCAPULA	SCAPULA FRAGMENT	METAPODIAL	CALCANEUM & ASTRAGALUS	COMMENTS
SHAK	A	6																						1	1														
SHAK	A	6																								1													
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SHAK	B	5												1																									
SHAK	B	6																				1																	L & R PREMAX JOINED
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SHAK	B	6																		1					1														SLEPHANT SHREW
SHAK	B	6																											1										
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SHAK	Z	3							1																														
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SHAK	Z	4																		1					1														S-MOLAR
SHAK	Z	4																						1	1														

ACRONYM	SQUA	NO	FEMUR COMPLETE	FEMUR SHAFT	FEMUR PROXIMAL	FEMUR DISTAL	TIBIA COMPLETE	TIBIA SHAFT	TIBIA PROXIMAL	TIBIA DISTAL	HUMERUS COMPLETE	HUMERUS SHAFT	HUMERUS PROXIMAL	HUMERUS DISTAL	RADIUS COMPLETE	RADIUS PROXIMAL	ULNA COMPLETE	ULNA PROXIMAL	CRANIAL FRAGMENT	MANDIBLE	MANDIBLE FRAGMENT	PREMAXILLA	PREMAXILLA FRAGMENT	MAXILLA	DAMAGE CATEGORY	SINGLE INCISORS	INCISIOR FRAG	SINGLE MOLARS	VERTEBRA	1/2-3/4 VERTEBRA	COMPLETE INNOMINATE	PORTION OF INNOMINATE	CLAVICLE	SCAPULA	SCAPULA FRAGMENT	METAPODIAL	CALCANEUM & ASTRAGALUS	COMMENTS
SHAK	Z	4																	1						2													
SHAK	Z	4			1																																	
SHAK	Z	4				1																																
SHAK	Z	4																											2									
SHAK	Z	4																											1									
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SHAK	Z	5																		1					2													
SHAK	Z	5																												1								
SHAK	Z	5			1																																	
SHAK	Z	5																											2									
SHAK	Z	5																														1						
SHAK	Z	5																								1												
SITH	A	8																						1	1													
SITH	A	8																						1	2													
SITH	A	8												1																								
SITH	A	8																		1					4													SHRIW
SKHA	C	5																				1																
SKHA	C	5																								1												
SLAG	B	3																		1					1													
SLAG	B	3	1																																			
SLAG	B	3	1																																			
SLAG	B	3																								1												
SLAG	C	3			1																																	
SLOP	A	4												1																								
SLOP	A	4																																				
SLOP	A	4																		1					1													
SLOP	A	5																		1					1													
SLOP	A	5																		1					1													
SLOP	A	5					1																															
SLOP	A	5					1																															
SLOP	A	5																								3												
SLOP	A	5																		1					1													
SLOP	A	5							1																		1											
SLOP	A	5									1																											
SLOP	A	5																		1					8													
SLOP	A	5																		1					1													
SLOP	A	5								1																												
SLOP	A	5	1																																			
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SLOP	A	5																		1					1													
SLOP	B	5														1																						
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SLOP	B	6																		1					8													
SLOP	B	6																		1					1													
SLOP	B	6																															1					
SLOP	B	6																		1					8													
SLOP	B	6																						1	1													
SLOP	B	6																		1					8													
SLOP	B	6																				1																L & R PREMAX JOINED
SLOP	B	6																						1	2													
SLOP	B	6																		1					1													
SLOP	B	6																				1																L & R PREMAX JOINED
SLOP	B	6																											1									
SLOP	B	6							1																													
SLOP	B	6																				1																
SLOP	B	6						1																														
SLOP	B	7																		1					1													
SLOP	B	7																										1										
SLOP	B	7					1																															
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SLOP	B	7	1																																			
SLOP	B	7	1																																			
SLOP	B	7																				1																
SLOP	B	7																									1											
SMT	Z	8																																	1			
SMT	Z	8								1																												
SMOK	A	1			1																																	
SMOR	A	2			1																																	
SMOK	A	2																						1	2													
SMOK	A	2			1																																	

			FEMUR	FEMUR	FEMUR	FEMUR	TIBIA	TIBIA	TIBIA	TIBIA	HUMERUS	HUMERUS	HUMERUS	HUMERUS	RADIUS	RADIUS	ULNA	ULNA	CRANIAL	MANDIBLE	MANDIBLE	PREMAXILLA	PREMAXILLA	MAXILLA	DAMAGE	SINGLE	INCISIOR	SINGLE	VERTEBRA	1/2-3/4	COMPLETE	PORTION OF	CLAVICLE	SCAPULA	SCAPULA	METAPODIAL	CALCANEUM &	
ACRONYM	SQUA	NO	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	PROXIMAL	COMPLETE	PROXIMAL	FRAGMENT		FRAGMENT		FRAGMENT		CATEGORY	INCISORS	FRAG	MOLARS		VERTEBRA	INNOMINATE	INNOMINATE			FRAGMENT		ASTRAGALUS	COMMENTS
SMOK	A	2																		1					1													
SMOK	A	3	1																																			
SMOK	A	3																														1						
SMOK	A	3																						1	1													
SMOK	A	4																									2											
SMOK	A	4	1																																			
SMOK	A	4	1																																			
SMOK	A	4																										1										
SMOK	B	1									1																											GOLDEN MILE
SMOK	B	3	1																																			
SMOK	B	3				1																																
SMOK	B	3			1																																	
SMOK	B	4																						1	2													
SMOK	B	4												1																								
SMOK	Y	3																														1						
SMOK	Y	3																														1						
SMOK	Y	3																		1					4.3													
SMOK	Y	3	1																																			
SMOK	Z	3																		1					1													
SMOK	Z	3																		1					4													SHREW
SMOK	Z	3	1																																			
SMOK	Z	3																								1												
SMOK	Z	3												1																								
SMOK	Z	3																						1	3													
SMOK	Z	4																		1					1													
SOIL	X	4			1																																	
SOIL	X	4																								3												
SOIL	X	4																		1					2													
SOIL	X	4																										3										
SOIL	X	4																						1	2													
SOIL	X	4																				1																
SOIL	X	4																		1					0													
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SOIL	X	4																						1	2													
SOIL	X	4																		1					2													
SOIL	X	4																									3											
SOIL	X	4																		1					3													
SOIL	X	4																		1					4,1													
SOIL	X	4																						1	1													
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SOIL	X	4																										1										
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SOIL	X	6																		1					1													
SOIL	X	6																								1												
SOIL	Y	4																																		1			
SOIL	Y	4																				1						1										JOINED TO L PREMAX FRAGMENT
SOIL	Y	4																						1	1													
SOIL	Y	4																									2											
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SOIL	Y	5																		1					1													
SOIL	Y	5					1																															
SOIL	Y	6	1																																			
SOIL	Y	5																		1					1													
SOIL	Y	5																		1					3													
SOIL	Y	5						1																														
SOIL	Y	5							1																													
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SOIL	Y	5																				1																
SOIL	Y	5																						1	2													
SOIL	Y	6	1																																			

			FEMUR	FEMUR	FEMUR	FEMUR	TIBIA	TIBIA	TIBIA	TIBIA	HUMERUS	HUMERUS	HUMERUS	HUMERUS	RADIUS	RADIUS	ULNA	ULNA	CRANIAL	MANDIBLE	MANDIBLE	PREMAXILLA	PREMAXILLA	MAXILLA	DAMAGE	SINGLE	INSCISOR	SINGLE	VERTEBRA	1/2-3/4	COMPLETE	PORTION OF	CLAVICLE	SCAPULA	SCAPULA	METAPODIAL	CALCANEUM &	
ACRONYM	SQUA	NO	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	PROXIMAL	COMPLETE	PROXIMAL	FRAGMENT		FRAGMENT		FRAGMENT		CATEGORY	INSCISORS	FRAG	MOLARS		VERTEBRA	INNOMINATE	INNOMINATE			FRAGMENT		ASTRAGALUS	COMMENTS
SOIL	Y	6																														1						
SOIL	Y	6																		1					2													
SOIL	Y	6																		1					1													
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SOIL	Z	6																		1					1													
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SOIL	Z	6																		1					1													
SOIL	Z	6																		1					1													
SOIL	Z	6																				1																
SOIL	Z	6																																	1			
SOIL	Z	6																										4										
SOIL	Z	6																		1					1													
SOIL	Z	6																		1					1													
SOIL	Z	6					1																															
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SOIL	Z	6																										2										
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SOIL	Z	6																		1					1													
SOIL	Z	6																		1					1													
SOIL	Z	6																		1					4													
SOIL	Z	6																						1	2													
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SOIL	Z	6																										2										
SOIL	Z	6	1																																			
SOIL	Z	6																						1	2													
SOIL	Z	6									1																											
SOIL	Z	6																		1					0													
SOIL	Z	6	1																																			
SOIL	Z	6																		1					0													
SOIL	Z	6																				1																
SOIL	Z	6																						1	2													
SOIL	Z	6	1																																			
SOIL	Z	6																						1	3													
SOIL	Z	6																				1																
SOIL	Z	6																		1					2													
SOIL	Z	6																		1					1													
SOIL	Z	6																						1	2													
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SOIL	Z	6																		1					1													
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SOIL	Z	6																									2											
SOIL	Z	6																				1																
SOIL	Z	6																						1	2													
SOIL	Z	6																									2											
SOIL	Z	6																														1						
SOIL	Z	6																		1					4,1													

			FEMUR	FEMUR	FEMUR	FEMUR	TIBIA	TIBIA	TIBIA	TIBIA	HUMERUS	HUMERUS	HUMERUS	HUMERUS	RADIUS	RADIUS	ULNA	ULNA	CRANIAL	MANDIBLE	MANDIBLE	PREMAXILLA	PREMAXILLA	MAXILLA	DAMAGE	INCISOR	INCISOR	INCISOR	VERTEBRA	1/2-3/4	COMPLETE	PORTION OF	CLAVICLE	SCAPULA	SCAPULA	METAPODIAL	CALCANEUM &	
ACRONYM	EQUA	NO	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	PROXIMAL	COMPLETE	PROXIMAL	FRAGMENT		FRAGMENT		FRAGMENT		CATEGORY	INCISORS	FRAG	MOLARS		VERTEBRA	INNOMINATE	INNOMINATE			FRAGMENT		ASTRAGALUS	COMMENTS
SOIL	Z	6																						1	2													
SOLE	A	2																						1	1													
SOLE	A	2																									1											
SOLE	A	2							1																													
SOLE	A	2								1																												
SOLE	A	2								1																												
SOLE	A	2																		1					1													
SOLE	A	3									1																											
SOLE	A	3									1																											
SOLE	B	3					1																															
SOLE	B	2												1																								
SOLE	B	2									1																											
SOLE	B	2					1																															
SOLE	B	3				1																																
SOLE	B	2																																				
SOLE	B	2			1																																	
SOLE	B	2																						1	1													
SOLE	B	2			1																																	
SOME	C	7																											1									
SOME	C	7																										1										
SOME	C	7																						1	2													
SOME	C	7																														1						
SOME	C	7																		1					1													
SOME	C	7					1																															
SOME	C	7																		1					3													
SOME	C	7																						1	1													
SOME	C	7																						1	2													
SOME	C	7																				1																
SOME	C	7																				1																
SOME	C	7																						1	2													
SOME	C	7																						1	1													
SOME	C	7																						1	2													
SOME	C	7																						1	2													
SOME	C	7				1																																
SOME	C	7																									1											
SOME	C	7																				1																
SOME	C	7						1																														
SOME	C	7			1																																	
SOSA	C	6																		1						1												
SOSE	A	2																		1					2													
SOSE	A	2																								1												
SOSE	C	3								1																												
SOSE	C	6																									1											
SOSE	C	6																						1	2													
SOSE	C	6																						1	1													
SOSE	C	6																		1					1													
SOSE	C	6																								2												
SOSE	C	6																										1										
SOSE	C	6			1																																	
SOSE	D	6																														1						
SOSE	D	6																		1					2													
SOSE	D	6																								2												
SOSE	D	6				1																																
SOSE	D	6												1																								
SOSE	X	2																														1						
SOSE	X	2					1																															
SOSE	X	3	1																																			
SOSE	X	4			1																																	
SOSE	Y	2			1																																	
SOSE	Y	2			1																																	
SOSE	Y	2																						1	3													
SOSE	Y	2																										1										
SOSE	Y	2																		1					2													
SOSE	Y	3										1																										GOLDEN MOLE
SOSE	Y	4												1																								
SOSE	Y	4			1																																	
SOSE	Y	4													1																							
SOSE	Y	6																								1												
SOSE	Z	2												1																								
SOSE	Z	2																																			1	
SOSE	Z	2												1																								
SOSE	Z	2			1																																	
SOSE	Z	2												1																								
SOSE	Z	2																1																				
SOSE	Z	2																													1							
SOSE	Z	2	1																																			
SOSE	Z	2								1									1																			
SOSE	Z	2									1																											
SORE	Z	3																						1	2													
SORE	Z	3																			71				3													
SOSE	Z	4																												2								
SOSE	Z	4																										1										

			FEMUR	FEMUR	FEMUR	FEMUR	TIBIA	TIBIA	TIBIA	TIBIA	HUMERUS	HUMERUS	HUMERUS	HUMERUS	RADIUS	RADIUS	ULNA	ULNA	CRANIAL	MANDIBLE	MANDIBLE	PREMAXILLA	PREMAXILLA	MAXILLA	DAMAGE	SINGLE	INCISOR	SINGLE	VERTEBRA	1/2-3/4	COMPLETE	PORTION OF	CLAVICLE	SCAPULA	SCAPULA	METAPODIAL	CALCANEUM &	
ACRONYM	SQUA	NO	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	PROXIMAL	COMPLETE	PROXIMAL	FRAGMENT		FRAGMENT		FRAGMENT		CATEGORY	INCISORS	FRAG	MOLARS		VERTEBRA	INNOMINATE	INNOMINATE			FRAGMENT		ASTRAGALUS	COMMENTS
SOSE	Z	4																																			1	
SOSE	Z	4									1																												GOLDEN MOLE
SOSE	Z	4																1																					
SOSE	Z	4																		1					2,4														ELEPHANT SHREW
SOSE	Z	4																																			4		
SOSE	Z	5			1																																		
SOSE	Z	5																		1					1														
SOSU	Y	5			1																																		
SOSU	Y	5																		1					1														
SOSU	Y	6																1																					
SOSU	Y	6																		1					2														
SOSU	Y	6																			71				3														
SOSU	Y	6																									2												
SOSU	Y	6																									1												
SOSU	Y	6																											1										
SOSU	Y	6																		1					1														
SOSU	Y	6																										2											
SOSU	Y	6							1																														
SOSU	Y	6																										1											
SOSU	Z	6																		1					1														
SOSU	Z	6																		1					1														
SOSU	Z	6						1																															
SOSU	Z	6																		1					1														
SOSU	Z	6									1																												
SOYI	A	8																														1							
SOYI	A	8																											1										
SOYI	A	8												1																									
SOYI	A	8							1																														
SOYI	A	8							1																														
SOYI	A	8																		1					2,4														
SOYI	A	8			1																																		
SOYI	A	8						1																															
SOYI	A	8																		1					2														
SOYI	A	8																									1												
SOYI	A	8												1																									
SOYI	A	8				1																										1							
SOYI	A	8						1																															
SOYI	A	8			1																																		
SOYI	A	8																													3								
SOYI	A	8							1																														
SOYI	A	8																								2						1							
SOYI	A	8																		1					4														
SOYI	A	8																1						1	2														
SOYI	A	8																			1				3														
SOYI	A	8												1																									
SOYI	A	8							1																														
SOYI	A	8																																					
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SOYI	A	8																																					
SOYI	A	8							1																														
SOYI	A	8																						1	2														
SOYI	A	8																		1					2														
SOYI	A	8																		1					3														
SOYI	A	8																										2											
SOYI	A	8																																					
SOYI	A	8																																					
SOYI	Z	8																					1					2											
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SOYI	Z	8			1																																		
SOYI	Z	8																		1					3														
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ACRONYM	SQUA	NO	FEMUR COMPLETE	FEMUR SHAFT	FEMUR PROXIMAL	FEMUR DISTAL	TIBIA COMPLETE	TIBIA SHAFT	TIBIA PROXIMAL	TIBIA DISTAL	HUMERUS COMPLETE	HUMERUS SHAFT	HUMERUS PROXIMAL	HUMERUS DISTAL	RADIUS COMPLETE	RADIUS PROXIMAL	ULNA COMPLETE	ULNA PROXIMAL	CRANIAL FRAGMENT	MANDIBLE	MANDIBLE FRAGMENT	PREMAXILLA	PREMAXILLA FRAGMENT	MAXILLA	DAMAGE CATEGORY	SINGLE INCISORS	INCISOR FRAG	SINGLE MOLARS	VERTEBRA	1/2-3/4 VERTEBRA	COMPLETE INNOMINATE	PORTION OF INNOMINATE	CLAVICLE	SCAPULA	SCAPULA FRAGMENT	METAPODIAL	CALCANEUM & ASTRAGALUS	COMMENTS
SOYI	Z	6			1																																	
SOYI	Z	6																																			1	
SOYI	Z	6																											1									
SPAD	A	7								1																												
SPAD	A	7																								1												
SPAD	A	7																				1																
SPAD	Z	6																				1		2														
SPAL	D	4			1																																	
SPAS	X	2																		1				1														
SPAS	X	2																										1										
SPAS	X	2																		1				3														
SPAS	X	2																		1				4,1														
SPO1	C	5																										1										
SPO2	B	8	1																																			
SPO2	C	6																		1				1														
SPO3	C	8			1																																	
STRA	A	4					1																															
STRA	A	4																											1									
STRA	A	5																										1										
STRA	A	5																		1				2														
STRA	A	5																				1																
STRA	A	5	1																																			
STRA	A	5																						1														
STRA	A	5	1																																			
STRA	A	5																		1				1														
STRA	A	6																																				
STRA	A	6																				1		2														
STRA	A	6																				1																L & R PREMAX JOINED
STRA	A	6																								5												
STRA	A	6																					1															
STRA	A	6																		1				1														
STRA	A	6																											1									
STRA	A	6																				1																L & R PREMAX JOINED
STRA	A	6							1																													
STRA	Z	4																		1				2														
STRA	Z	4																		1				1														
STRA	Z	4																		1				1														
STRA	Z	4																		1				1														
STRA	Z	6																								2												
STRA	Z	6																		1				8														SHREW
STRA	Z	6																				1																L & R PREMAXILLA JOINED
STRA	Z	6																				1																L & R PREMAXILLA JOINED
STRA	Z	6																								2												
STRA	Z	6																						1														
STRA	Z	6																						1					3									
SURF	C	6																	1								1											
SURF	C	6																																				
SURF	Y	6														1																						
SURF	Y	6														1																						
SUTR	A/B	7			1																																	
SWGO	B	9																														1						
SWGO	B	9																								1												
SWGO	B	9			1																																	
SWGO	B	9																																	1			
SWGO	B	9			1																																	
TAPT	D	4																						1	2													
TOMM	Y	7																								1												
TOMM	Y	7							1																													
TOMM	Y	7																		1				3														
TOMM	Y	7																						1	2													
TOPD	A	7																									1											
TOPD	A	7				1																																
TOPD	A	7																		1				1														
TOPD	A	7																						1	2													
TOPD	A	7				1																																
TOPD	A	7								1																												
TOPD	A	7																		1				4,1														
TOPD	A	7																								1												
TOPD	A	7																											1									
TOPD	A	7							1																													
TOPD	A	7			1																																	DAMAGED
TOPD	A	7																		1				3														
TOPD	A	7																										2										
TOPD	A	7																		1				3														SHREW
TOPD	A	7							1																													
TOPD	A	7																1																				
TOPD	C	6																								1												
TOPD	Z	7																				1																
TOPD	Z	7																								1												
TREF	C	6			1																							1										
TREF	C	6																																				
TREF	C	6																						71	3													
TUTA	A	7																						1	2													
TUTA	A	7																						1	3													
TUTA	A	7																		9					1													SHREW
TUTA	A	7																			71				3													

ACRONYM	SQUA	NO	FEMUR COMPLETE	FEMUR SHAFT	FEMUR PROXIMAL	FEMUR DISTAL	TIBIA COMPLETE	TIBIA SHAFT	TIBIA PROXIMAL	TIBIA DISTAL	HUMERUS COMPLETE	HUMERUS SHAFT	HUMERUS PROXIMAL	HUMERUS DISTAL	RADIUS COMPLETE	RADIUS PROXIMAL	ULNA COMPLETE	ULNA PROXIMAL	CRANIAL FRAGMENT	MANDIBLE	MANDIBLE FRAGMENT	PREMAXILLA	PREMAXILLA FRAGMENT	MAXILLA	DAMAGE CATEGORY	SINGLE INSCISORS	INCISOR FRAG	SINGLE MOLARS	VERTEBRA	1/2-3/4 VERTEBRA	COMPLETE INNOMINATE	PORTION OF INNOMINATE	CLAVICLE	SCAPULA	SCAPULA FRAGMENT	METAPODIAL	CALCANEUM & ASTRAGALUS	COMMENTS
TUTA	A	7																		1					1													
TUTA	A	7																		1					1													
TUTA	A	7																										1										
TUTA	A	7																											1									
TUTA	A	7																	2																			
TUTA	A	7																								1												
TUTA	B	7																				1																
TUTA	B	7																						1	2													
TUTA	B	7																						1	1													
TUTA	B	7								1																												
TUTA	B	7									1																											
TUTA	B	7																		1					1													
TUTA	B	7																		1					2	1												
TUTA	B	7																						1	2													
TUTA	B	7																								8												
TUTA	B	7																						1	1													
TUTA	B	7																				1																
TUTA	B	7																											3									
TUTA	B	7																						1	2													
TUTA	B	7																						1	2													
TUTA	B	7																												1								
TUTA	B	7																														1						
TUTA	B	7			1																																	
TUTA	B	7			1																																	
TUTA	B	7																														1						
TUTA	B	7																		1					1													
TUTA	B	7												1																								
TUTA	B	7																				1																
TUTA	B	7																									1											
TUTA	B	7																		1					0													SHREW
TUTA	B	7																		1					2													
TUTA	B	7												1																								
TUTA	B	7												1																								
TUTA	B	7																		1					2													
TUTA	B	7				1																																
TUTA	B	7																		1					2													
TUTA	B	7																		1					2													

ACRONYM	SQUARE	NO	FEMUR COMPLETE	FEMUR SHAFT	FEMUR PROXIMAL	FEMUR DISTAL	TIBIA COMPLETE	TIBIA SHAFT	TIBIA PROXIMAL	TIBIA DISTAL	HUMERUS COMPLETE	HUMERUS SHAFT	HUMERUS PROXIMAL	HUMERUS DISTAL	RADIUS COMPLETE	RADIUS PROXIMAL	ULNA COMPLETE	ULNA PROXIMAL	CRANIAL FRAGMENT	MANDIBLE	MANDIBLE FRAGMENT	PREMAXILLA	PREMAXILLA FRAGMENT	MAXILLA	DAMAGE CATEGORY	SINGLE INCISORS	INCISOR FRAG	SINGLE MOLARS	VERTEBRA	1/2-3/4 VERTEBRA	COMPLETE INNOMINATE	PORTION OF INNOMINATE	CLAVICLE	SCAPULA	SCAPULA FRAGMENT	METAPODIAL	CALCANEUM & ASTRAGALUS	COMMENTS
UBED																																1						
UBED					1																																	
UBED															1																							
UBED	C	6																		1					2													
UBED	C	6																		1					1													
UBED	C	6																		1					2													
UBED	C	6																		1					1													
UBED	C	6																		1					4,3													
UBED	C	6																				2																
UBED	C	6																										2										
UBED	C	6																		1					3													
UBED	C	6																		1					3													
UBED	C	6												1																								
UBED	C	6																	1																			
UBED	C	6																				2																
UBED	C	6																		1					2													
UBED	C	6																	1																			
UBED	C	6																																				1X ? LONG BONE SHAFT
UBED	C	6																					?1															
UBED	C	6																		1					4,1													
UBED	C	6			1																																	
UBED	C	6																		1					1													
UBED	C	6																		1					6													
UBED	C	6																						1	3													
UBED	C	6																						1	1													
UBED	C	6																						1	1													
UBED	C	6																									2											
UBED	C	6																											3									
UBED	C	6																								6												
UBED	C	6																						1	2													
UBED	C	6																						1	3													
UBED	C	6																									3											
UBED	C	6								1																												
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UBED	C	6				1																																
UBED	C	6																										2										
UBED	C	6																										3										
UBED	C	6												1																								
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UBED	C	6								1																												
UBED	C	6																						1	2													
UBED	C	6											1																									
UBED	C	6								1																												
VIKI	Y	2																																				
VIKI	Y	2																		1					1													
VIKI	Y	2																											1									
WALL SCRA	B	4			1																																	
WALL SCRA	B	4			1																																	
WALL SCRA	B	4																		1					2													
WAYO	A	4			1																																	
WAYO	A	4																												1								
WAYO	A	4				1																																
WAYO	A	4																									1											
WAYO	A	4																1																				
WAYO	A	4																											1									
WAYO	A	4																						1	1													
WAYO	A	4																				1																L & R PREMAX JOINED
WAYO	A	4																		1					2													
WAYO	A	4																				1																L & R PREMAX JOINED
WAYO	A	4																						1	2													
WAYO	A	7																		1					1													

			FEMUR	FEMUR	FEMUR	FEMUR	TIBIA	TIBIA	TIBIA	TIBIA	HUMERUS	HUMERUS	HUMERUS	HUMERUS	RADIUS	RADIUS	ULNA	ULNA	CRANIAL	MANDIBLE	MANDIBLE	PREMAXILLA	PREMAXILLA	MAXILLA	DAMAGE	SINGLE	INCISOR	SINGLE	VERTEBRA	1/2-3/4	COMPLETE	PORTION OF	CLAVICLE	SCAPULA	SCAPULA	METAPODIAL	CALCANEUM &	
ACRONYM	SQUARE	NO	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	PROXIMAL	COMPLETE	PROXIMAL	FRAGMENT		FRAGMENT		FRAGMENT		CATEGORY	INCISORS	FRAG.	MOLARS		VERTEBRA	INNOMINATE	INNOMINATE			FRAGMENT		ASTRAGALUS	COMMENTS
WAYO	A	7																		1					1													
WAYO	A	7																														1						
WAYO	A	7																		1					3													R-NEW
WAYO	A	7																										2										
WAYO	A	7																										2										
WAYO	A	7																																	1			
WAYO	A	7																	3																			
WAYO	A	7																												4								
WAYO	A	7												1																								
WAYO	A	7												1																								
WAYO	A	7																									1											
WAYO	A	7							1																													
WAYO	A	7																		1					3													
WAYO	A	7												1																								
WAYO	A	7												1																								
WAYO	A	7											1																									
WAYO	A	7												1																								
WAYO	A	7			1																																
WAYO	A	7			1																																
WAYO	A	7			1																																
WAYO	A	7																								2											
WAYO	A	7												1																								
WAYO	A	7			1																																
WAYO	A	7				1																															
WAYO	A	7																									2										
WAYO	A	7																										1										
WAYO	A	7																		1					3													
WAYO	A	7																														1						
WAYO	A	7																											3									
WAYO	A	7			1																																
WAYO	A	7																																				
WAYO	A	7																1																				
WAYO	A	7				1																																
WAYO	A	7																				1						1										
WAYO	A	7																				1																
WAYO	A	7																						6														
WAYO	A	7																						1	1													
WAYO	A	7																			71				4,3													
WAYO	A	7																						1	1													
WAYO	A	7				1																																
WAYO	A	7																												7								
WAYO	A	7																						1	2													
WAYO	A	7																		1					3													
WAYO	A	7																																	1			
WAYO	A	7																						1	2													
WAYO	A	7																							2													
WAYO	A	7																		1					3													
WAYO	Z	7																1																				
WAYO	Z	7			1																																
WAYO	Z	7																1																				
WAYO	Z	7																						1	2													
WAYO	Z	7																		1					1													
WAYO	Z	7																			71				3													
WAYO	Z	7																												1								
WAYO	Z	7																										1										
WAYO	Z	7																1																				
WAYO	Z	7																		1					3													
WAYO	Z	7																						1	1													
WAYO	Z	7																						1	1													
WAYO	Z	7																						1	2													
WAYO	Z	7																								1												
WAYO	Z	7						1																														
WAYO	Z	7												1																								
WAYO	Z	7																								2												
WAYO	Z	7																		1					0													
WAYO	Z	7																												2								
WAYO	Z	7												1																								
WAYO	Z	7				1																								4								
WAYO	Z	7																						1	3													
WAYO	Z	7				1																										1						
WEBB	C	6																				1																
WEBB	C	6																		1					1													
WEBB	C	6																														1						
WEBB	C	6																				1																
WEBB	C	6																		1					1													
WEBB	C	6																								4												
WEBB	C	6																														1						
MNK	A	6	1																																			
MNK	A	6																						1	0													L & R MAX JOINED, R-NEW
MNK	A	6																						1	0													L & R MAX JOINED, R-NEW
MNK	A	6								1																												
MNK	A	6																			71				3													
MNK	A	6																												1								
MNK	B	6																						1	2													
MNK	Z	6																								1												
MNK	Z	6																									1											

			FEMUR	FEMUR	FEMUR	FEMUR	TIBIA	TIBIA	TIBIA	TIBIA	HUMERUS	HUMERUS	HUMERUS	HUMERUS	RADIUS	RADIUS	ULNA	ULNA	CRANIAL	MANDIBLE	MANDIBLE	PREMAXILLA	PREMAXILLA	MAXILLA	DAMAGE	SINGLE	INCISOR	SINGLE	VERTEBRA	1/2-3/4	COMPLETE	PORTION OF	CLAVICLE	SCAPULA	SCAPULA	METAPODIAL	CALCANEUM &	
ACRONYM	SQUARE	NO	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	SHAFT	PROXIMAL	DISTAL	COMPLETE	PROXIMAL	COMPLETE	PROXIMAL	FRAGMENT		FRAGMENT		FRAGMENT		CATEGORY	INCISORS	FRAG	MOLARS		VERTEBRA	INNOMINATE	INNOMINATE			FRAGMENT		ASTRAGALUS	COMMENTS
WERO	A	4	1																																			
WERO	B	4																		1					2														
WERO	B	4																											1									
WERO	B	4																								1												
YASM	X	3																		1					1												
YASM	Y	3																		1					1												
YASM	Y	3																									1										
YASM	Y	3																						1	2												
YASM	Y	3			1																																
YASM	Y	3																		1					1												
YASM	Y	3								1																												
ZAMB	B	4					1																															
ZOST	A	6																1																				
ZOST	A	6								1																												
ZOST	A	6																		1					1													
ZOST	A	6																		1					4,1													SHREW
ZOST	A	6																						1	2													
ZOST	A	6																		1					4,1													SHREW
ZOST	A	6																				1																
ZOST	A	6																						1	2													
ZOST	A	6				1																				3												
ZOST	A	6																				1						1										
ZOST	A	6																1																				
ZOST	A	6																						1	2													
ZOST	B	6																		1																		
ZOST	B	6												1																								
ZOST	B	6	1																																			
ZOST	B	6																		1					2													
ZOST	B	6																													1							
ZOST	B	6																						1	8													L & R MAXILLA JOINED
ZOST	B	6																						1	8													L & R MAXILLA JOINED
ZOST	B	6																														1						
ZOST	B	6																		1					3													
ZOST	B	6																											1									
ZOST	B	6																						1	2													
ZOST	B	6																						1	1													
ZOST	B	6																						1	2													
ZOST	B	6																		1					2													
ZOST	B	6																				1																
ZOST	B	6																		1					4,1													
ZOST	B	6																		1					1													
ZOST	B	6								1																		1										
ZOST	B	6								1																												
ZOST	B	6																		1					1				1									
ZOST	B	6																								2												
ZOST	B	6																		1					1													
ZOST	B	6																		1					1													
ZOST	Z	6								1																												
ZOST	Z	6																1																		1		

Appendix 6

The frog and lizard bones from Elands Bay Cave

The frog bones from Elands Bay Cave -

Package	Femur	Tibio-fibula	Humerus	Distal Humerus	Radio-ulna	Vertebra	Vertebra 1/2-3/4	Meta-podials	Pelvic girdle	Sacrum & 1/2-3/4 urostyle	Urostyle only	Coracoid	Scapula	Calcaneum & astragalus	Comments
2a					1										
3a		1		1	1		1		2	1	1	2			
8a			1	1		1			1			1		1	
8b									1						
9				1											
11a	?1														
15b				1				1							
16c			1												*Xenopus*
17a								1					1		

The lizard bones from Elands Bay Cave -

Package	Humerus	Distal Humerus	Mandible	Mandible Fragment	Maxilla Fragment	Cranial Fragment	Vertebra	Pelvic Girdle	Pelvic Girdle Fragment
3a	6		5	2		2		4	3
3d				1					
4c			2						
5c	2	1						1	
8a	3	1			1				
8b			2			1			
9	2		1						
12						1			
13		1							
15b			1				1		
16c			1						
18b		1							
19a				3					